

CONTRACTORS' & ENGINEERS' MONTHLY

A Purchasing Guide for Engineers, Contractors, Public Officials
and Other Purchasers of Construction Materials
and Equipment.



TEXACO Asphalt Macadam on Western Avenue, Lake Forest, Ill.
Completed June, 1915. Photo taken July, 1919.

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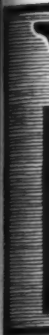
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Where to Purchase

A comprehensive Directory of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may desire to secure catalogs or prices on construction equipment. Where the name of a manufacturer is preceded by a star (*) it indicates that the user of the directory may secure further information by referring to the manufacturer's advertisement in this issue. The index to advertisers will be found on page facing the inside back cover.

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Linde Air Products Co., New York.
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ACETYLENE APPARATUS

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*Texas Co., N. Y. C.
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Concrete Steel Co., New York.
Electric Welding Co., Pittsburgh, Pa.
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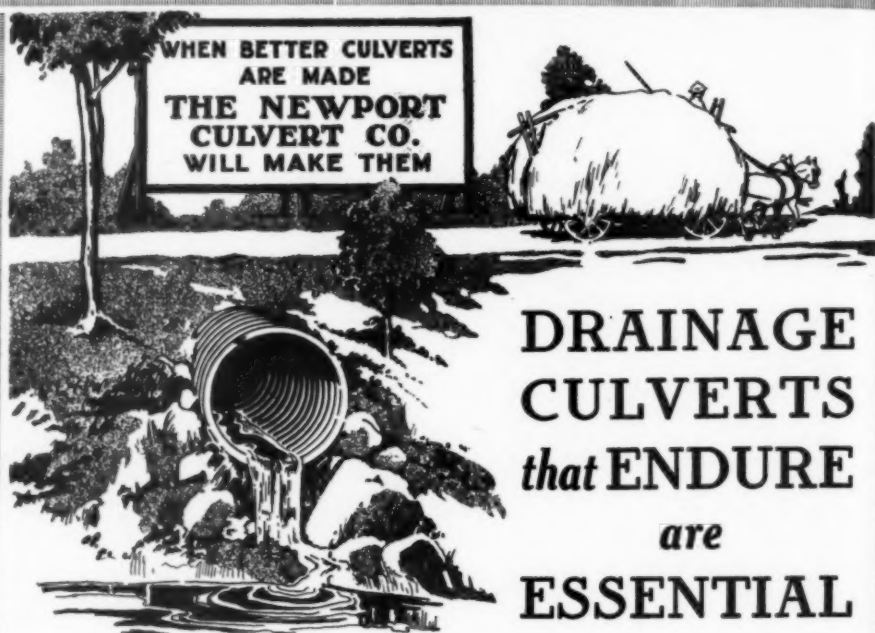
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Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Lackawanna Steel Co., Buffalo, N. Y.
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*Walde Bros. & Bond Co., Boston, Mass.
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*Union Water Meter Co., Worcester, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
United Brass Mfg. Co., Cleveland, O.

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Bellefontaine Bridge & Steel Co., Bellefontaine, O.
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Chesapeake Iron Works, Baltimore, Md.
Eastern Bridge & Struct. Co., Worcester, Mass.
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Fort Pitt Bridge Works, Pittsburgh, Pa.
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Ingalls Iron Works, Birmingham, Ala.
Inland Steel Co., Chicago, Ill.
Inter. Steel & Iron Co., Evansville, Ind.
King Bridge Co., Cleveland, O.
Lackawanna Bridge Co., Buffalo, N. Y.
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Louisville Bridge & Iron Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Bridge Co., Milwaukee, Wis.
Minn. Steel & Mch'y. Co., Minneapolis, Minn.
Missouri Vy. Bldg. & Iron Co., Leavenworth, Kan.
Morera Constr. Co., Chicago, Ill.
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Penn. Bridge Co., Beaver Falls, Pa.
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Riverside Bridge Co., Martins Ferry, O.
Toledo Crane Co., Toledo, O.
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Browning Co., Cleveland, O.
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Hayward Co., N. Y. C.
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Lakewood Engineering Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Orton & Steinbrenner, Chicago, Ill.
Vulcan Iron Works, Jersey City, N. J.
Williams Co., G. H., Erie, Pa.

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*The
Heavy Duty
Mixer*



Fortified Against the Greatest of Concrete Mixer Strains

WRENCHING strains of a loaded charging skip punish every part of a mixer, unless, like the Koehring, the mixer has the super-strong main frame and super-structure, liberally cross-membered, joints machined to perfect fit—strongly gusseted and angle braced.

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- Browning Co., Cleveland, O.
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- Monaghan Machine Co., Chicago, Ill.
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- Williams Bucket Co., Erie, Pa.

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- Industrial Works, Bay City, Mich.
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- McMyler Interstate Co., Cleveland, O.
- Mead-Morrison Mfg. Co., East Boston, Mass.
- Orton & Steinbrenner Co., Chicago, Ill.
- Vulcan Iron Works, Jersey City, N. J.

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- Saunders Bros., Chicago, Ill.
- Waterbury Co., N. Y. C.

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- Petroleum Iron Works Co., Sharon, Pa.

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- Marchant Calc. Machine Co., Oakland, Cal.

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- Continental Car Co. of Am., Louisville, Ky.
- Easton Car & Constr. Co., N. Y. C.
- Elec. Wheel Co., Quincy, Ill.
- Georgia Car & Loco. Co., Atlanta, Ga.
- Inley Mfg. Co., Indianapolis, Ind.
- Kilbourne & Jacobs Mfg. Co., Columbus, O.
- Lakewood Engineering Co., Cleveland, O.
- Oliver Mfg. Co., W. J., Knoxville, Tenn.
- Ramapo Iron Works, Hillburn, N. Y.
- Smith Co., T. L., Milwaukee, Wis.
- Southern Iron & Equip. Co., Atlanta, Ga.
- Stuehner Iron Works, G. L., Long Island City, N. Y.
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- Sterling Wheelbarrow Co., Milwaukee, Wis.
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- *Central Fdry. Co., N. Y. C.
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- *Lynchburg Fdry. Co., Lynchburg, Va.
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- *Warren Fdry. & Mach. Co., N. Y. C.
- Camden Iron Works, Camden, N. J.
- Flower Valve Mfg. Co., Detroit, Mich.
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- Jeffrey Mfg. Co., Columbus, O.
- Marion Malleable Iron Works, Marion, Ind.
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- *Smith Mfg. Co., A. P., East Orange, N. J.
- Helwig Mfg. Co., St. Paul, Minn.
- Ingersoll-Rand Co., N. Y. C.

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- *Fenna Cement Co., New York.
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- Canada Cement Co., Ltd., Montreal, Can.
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- Crescent Portland Cement Co., Wampum, Pa.
- Dewey Portland Cement Co., Kansas City, Mo.
- Dixie Portland Cement Co., Chattanooga, Tenn.
- Lehigh Portland Cement Co., Allentown, Pa.
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- Riverside Portland Cement Co., Los Angeles, Cal.
- Sandusky Cement Co., Cleveland, Ohio.
- Texas Portland Cement Co., Dallas, Tex.
- Universal Portland Cement Co., Chicago, Ill.
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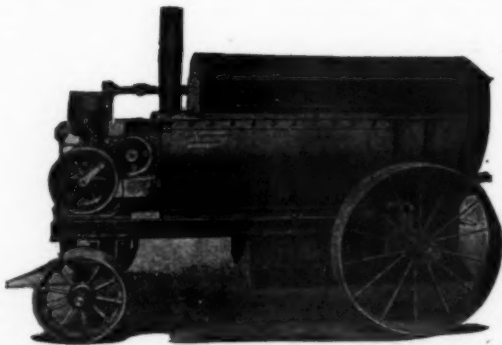


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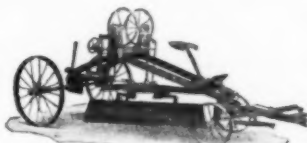
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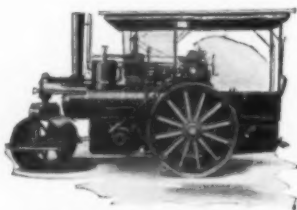
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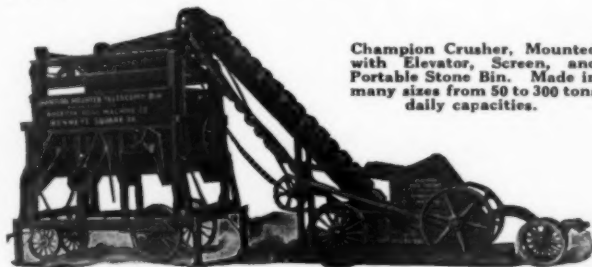
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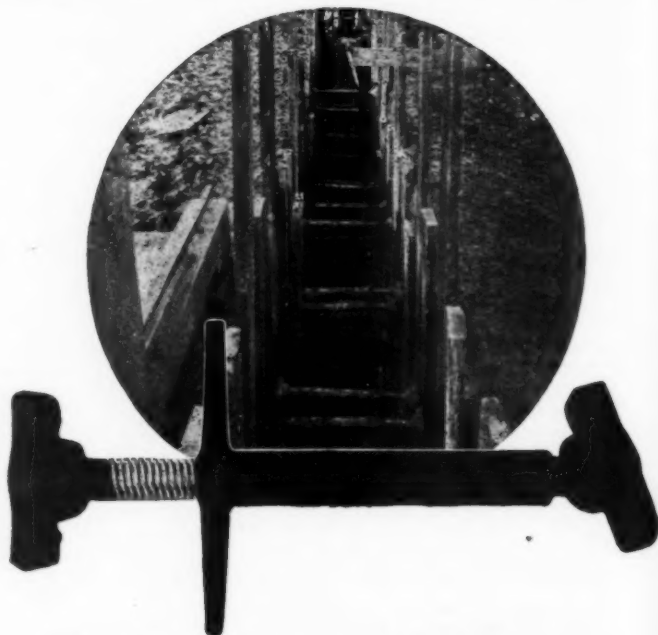
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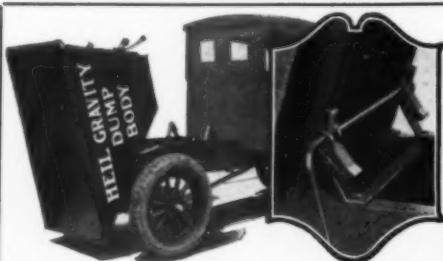
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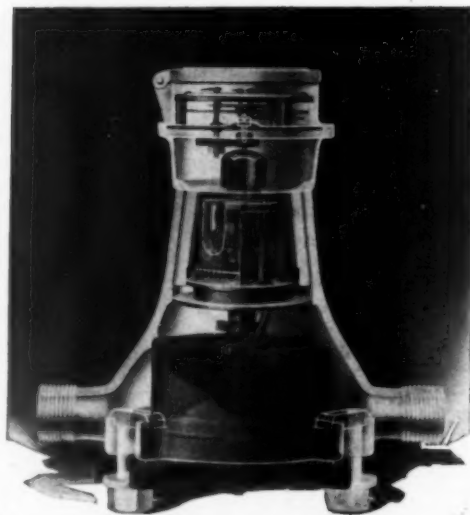
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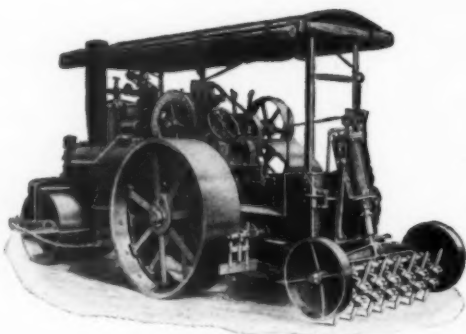
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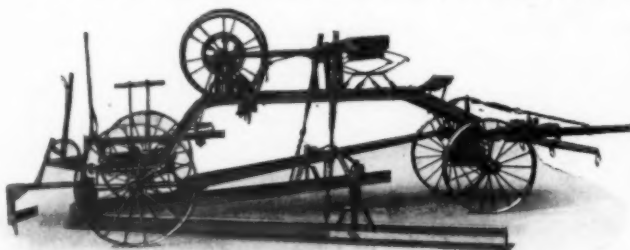


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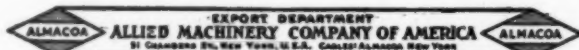
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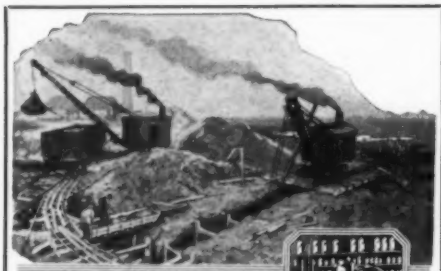
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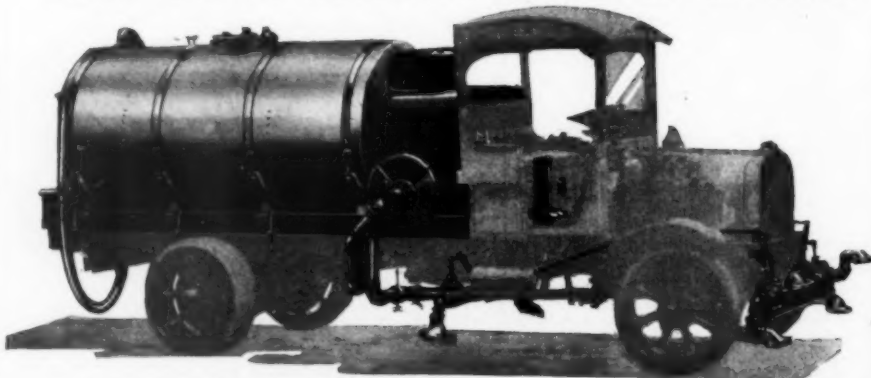
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Horsepower: 12 at drawbar, 20 at belt-pulley
Length: 96 inches
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Height: 52 inches
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Center to Center of Tracks: 38 inches
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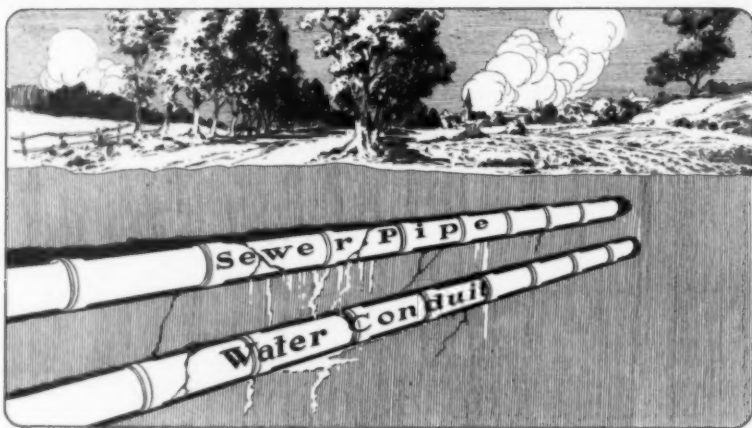
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A leaky joint in the sewer line caused polluting material to enter the water conduit and a thousand cases of Typhoid Fever resulted

THE SEWER LEAKED, AND THEN—

Salem, a prosperous Ohio town of about ten thousand inhabitants, had for years been drinking a presumably safe well water. Then in November, 1920, a terrible epidemic of Typhoid Fever struck a calamitous blow. Over eight hundred citizens were stricken by this dread disease.*

Help was rushed to Salem from all quarters—appeals were sent to the Red Cross for doctors and nurses—every effort was made to check the ravages of the disease and lessen the suffering of the afflicted.

And, since Typhoid Fever is a disease largely transmitted by drinking water—the water supply of Salem was investigated.

And what was found?

The picture above tells the story!

A leaky sewer—a leaky water conduit—typhoid laden sewage entered the drinking water—the citizens of Salem drank the water—then disease—pestilence—death!

Hurry up calls were sent to our factory. Within a few hours one of our Service Engineers was at Salem—placed a "W & T" Apparatus in operation—killed the Typhoid Germs by applying minute quantities of

Liquid Chlorine, and the typhoid epidemic was stopped.

But! That typhoid epidemic would never have occurred if the water had been continuously chlorinated. If Salem had placed a "W & T" Installation in service months before this epidemic started, then even if the sewer had leaked, there would have been no typhoid, for the minute quantities of chlorine added to the water would have killed the Typhoid Germs and made them harmless.

Think of the loss of life—the suffering—the resources that could have been saved by the timely installation of "W & T" Apparatus.

An ounce of chlorine will make twelve thousand gallons of water disease proof.

Chlorination giving absolute assurance of a safe water supply costs less than two cents per person for a year.

The point is—Don't wait for an epidemic to strike. Prepare by installing "W & T" Apparatus now. Follow the example of thousands of other communities that realize that the only safe water supply is a sterilized water supply.

*Reference—Eng. News Record—December 23, 1920.

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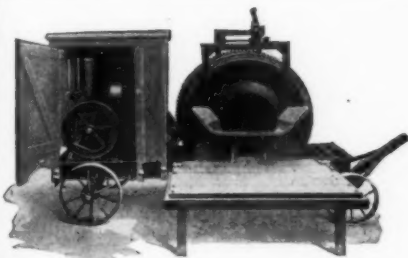
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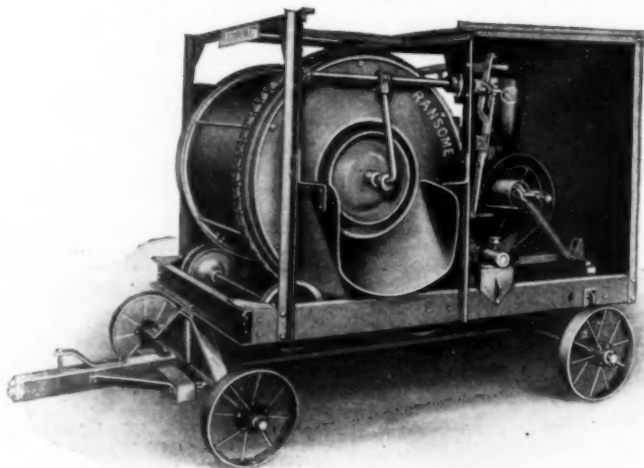
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TABLE OF CONTENTS FOR APRIL, 1921

EDITORIAL

	PAGE
Suggestions for Asphalt Paving Contractors.....	41
A Difficult Submarine Pipe Job.....	47
Purchase and Erection of Engineering Equipment.....	49
Data for Your Desk Files.....	53
Contractors', Engineers' and Manufacturers' Notes.....	55
Motor Trucks and Machinery in Service.....	56
Speeding Up Progress on New Roads.....	58
An Improved Steam Stump Puller and Piler.....	59
Five Chief Causes of Motor Truck Troubles.....	60
Modern Machinery Moves Historic Rock.....	61
Policy of State Highway Departments Regarding Open Highway Specifi- cations	62
Handling Building Material with Few Men	63
Storage Systems for Gravel and Crushed Stone.....	65
Special Dump Models for Contractors' Trucks.....	66
Motor Trucks Invaluable to Quarrymen.....	67
Bituminous Concrete Foundations.....	68
Penetration Macadam Roads.....	69
What Is a "Responsible Bidder"?.....	71
Earth Work on Road Jobs.....	72
Motor Truck Fleet Serves Stone Crusher.....	76
Negligence Cost \$8,000.....	78
A Gasoline Trenching Machine.....	80



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Contractors' & Engineers' Monthly

New York

April, 1921

Suggestions for Asphalt Paving Contractors*

Part I

By Henry B. Drowne

Division Engineer with The Lane Construction Corporation

CONTRACTS for roads are let in lengths varying from a few hundred feet to several miles. The small job ordinarily appeals more to the small contractor because not much plant equipment is required and a small amount of capital will carry the job through. Competition on the small jobs is usually keener than on the larger ones because of the greater number of bidders. Some contractors make a mistake in not giving enough attention to the small job after construction has started. Wrong methods used on a small job if not quickly corrected make a loss out of an item that otherwise might have shown a profit. A contractor with a large field organization must have some large jobs to keep his organization working smoothly, but he can frequently take on a number of small jobs to advantage for the following reasons:

The fact that conditions which prevail at the time a small job is taken may be expected to remain unchanged for the duration of the work enables the contractor to figure the work with some certainty. Conditions may be unsettled, and a few small jobs would be safer than one job which would equal the aggregate amount of the small jobs. For example, consider the matter of transportation alone. Assume that on a \$100,000 job stone shipments were made by rail and that on three \$30,000 jobs stone was shipped to the first by trolley, to the second by truck, and to the third by rail. In the event of a freight tie-up, car short-

age, or advance in freight rates the three small jobs would not be affected as much as the larger one. Labor shortage in one locality is often more acute than in another. Sufficient local labor may be found near a small job to do the work. The contractor can easily organize a force from such a source by adding to a nucleus from his own organization. A contractor who owns a large equipment will frequently have a machine idle that could be used to advantage if work for it was available. Generally small jobs do not require much plant. On many small jobs a steam roller is all that is needed in the way of big plant. A small job does not tie up a piece of plant for a long time, and coördinating jobs of this kind with the large jobs enables a contractor to keep his plant busy for practically the entire season. Foremen and engineers who form a part of the contractor's organization expect employment for the entire season. A small job may furnish the opportunity to use men of this kind to advantage where otherwise they would be carried on the payroll of some job where they were really not needed. As the work progresses on the large jobs, engineers and foremen become available for other work. A small job may be directed by a superintendent whose experience with work would not warrant his having charge of a large job. In a large organization there are superintendents of varied experience, and the contractor can get the best out of them by putting them in charge of work which fits their ability. Many contractors who have made a success in handling small jobs fail completely when

* EDITORIAL NOTE.—The text is reprinted by permission, from the forthcoming Brochure No. 13 of The Asphalt Association.

engaged on a big job, because in most instances they do not have the necessary resources to properly finance and equip the job.

Location of Work

It is always desirable to get new work near work that is being performed. If such a thing is possible, the expense of moving from one job to the other is reduced, and the new job can be coordinated with the other work to better advantage than if removed by a long distance. Moving on to a job to-day is a large item of expense where many men or much equipment is involved. Difficulties of transportation have been such that unless plant was available that could be put on the job ahead of the men, much lost time waiting for plant would occur. In certain parts of the country it is possible to carry on highway work throughout the year. In the northern states, however, eight months is about as long a period as can be expected in which work can be done to advantage. Work done in this locality in the winter months may speed up a job, but the expense of doing such work is usually prohibitive.

Examination of Work

It seems unnecessary to say that a contractor should always look over the job upon which he is going to bid. Actual conditions must be seen upon the ground to get at the real value of the work. The custom of bidding work within certain limits of an engineer's estimate of cost frequently causes many contractors who have put too much faith in the engineer's ideas of values to lose money. In the writer's opinion this method of controlling the bids has no merit at all. The contractor who knows the value of work needs no such assistance, and the only thing accomplished by the engineer's estimates is to tempt the inexperienced to try their luck, frequently accompanied with disastrous results. It is the practice of some engineering departments to make reports of materials which may be used in the work. The contractor, however, should look up his own sources of material supply.

Examination of Specifications

In connection with the examination of a road, the specification governing its construction should be carefully studied. What may be called stone fill in one state may be called stone subbase in another, and stone V-drain in another. All when built give the

same result, yet the construction details or methods of payment may be slightly different. For instance, in some places the stone base and the filler used to fill the voids are paid for as separate items; in other places the price of stone base includes the filler. A contractor who fails to gather such points from a reading of the specifications is bound to lose money.

Contractors frequently make mistakes in estimating the cost of borrow or gravel items where the borrow or gravel is measured in place on the road and not in the pits from which it was taken. It is wholly a matter of shrinkage, and the shrinkage will vary depending upon the kind of material, the relation of cut to fill, and the kind of work, whether heavy or light grading. If the material used is measured in the pits from which it is taken, the contractor is sure of being paid for work he has done, provided pits are correctly measured, but if the basis of payment is place measurement on the road and the correct allowance for shrinkage is not made, the contractor is obliged to supply the necessary material at his own expense. Harger and Bonney give the following ratios to use for shrinkage in ordinary cases:

Light skimming work, large amount of heavy sod	1.35
Light skimming work, considerable sod	1.30
Light skimming work, not much sod	1.25
Medium work	1.20
Heavy work	1.15

Specifications for crushed stone to be used in the work should be examined with care. The sizes to which the stone is to be crushed and the amount of each size to be used have a direct relation to the cost of crushing. Some specifications, in fact, fail to take care of the total output of the crusher, so that the contractor is left with a considerable quantity of material of certain sizes which cannot be used in the road. Unless a sale for this material can be found, it is a dead loss.

The clause, "to the satisfaction of the engineer," which appears so many times in all specifications, has an important bearing on the cost of work. Methods and results which may satisfy one engineer do not come up to the expectations of another. A personal knowledge of what an engineer expects and will demand can only be gained by the experience of doing some work under his direction.

It is necessary, also, for a contractor to consider the state and local laws relating to

the work to be done. One of the principal laws that affect the cost is the one establishing a certain number of hours for a day's work. If men have been working ten hours a day for fifty cents an hour it is difficult to place them on a job where eight hours is the day's work and satisfy them without advancing the hourly rate. Laws which require licensed engineers to operate certain kinds of plant cause a contractor no end of trouble sometimes where men in his own organization have no license or are unable to get one.

Small Tools

Money is frequently lost by the contractor's neglect to supply his men with the proper tools. Round-point shovels are used where square shovels would be better. Forks might do the work still better than either kind of shovels. Picks which are dull and short, shovels which are worn out, should be discarded for new ones. Old tools are always sought after by the lazy man, and a tool of the proper size and in good condition will force him to do something toward a day's work in spite of himself.

Plant for Grading

A great deal of bituminous road work to-day consists of reconstructing old road surfaces. Where no change of grade occurs, or no foundation work is required, the new subgrade is prepared by breaking up the old surface and reshaping it to conform to the new cross-section. The best machine to do this work is a steam scarifier. One type of scarifier of this kind is made to attach to the back of the three-wheel roller common to highway work. It consists essentially of a steam cylinder, the piston of which is connected to a bar in which the scarifying teeth are inserted. The bar carrying the teeth is about as wide as the back end of the roller, and the teeth are removable and adjustable, so that varying depths and widths can be scarified. Steam is connected from the roller to the cylinder on the scarifier and a throttle controls the raising and lowering of the bar carrying the teeth. When scarifying, the steam pressure on the piston forces the teeth into the surface. This type of scarifier will do the work of scarifying in a very satisfactory manner. Old macadam roads and some surfaces which have been treated with bituminous materials are easily broken up by a machine



TYPE OF BUCKET FOR ASPHALT ROAD WORK

of this type. When the material is loosened, a road machine drawn by horses or a gasoline tractor may be used to reshape the surface to conform to the new subgrade. In work of this kind practically none of the material is moved except toward the sides of the road on the shoulder. A final truing up by hand is all that is required to complete the subgrade for the new work.

In work where there is a movement of excavated material longitudinally along the road, other methods must be used. For very short hauls some form of drag or wheel scraper might be used. The hauls, however, in highway work are usually so long that the excavated material must be loaded into wagons or trucks to do the work economically. Where a steam shovel can be obtained, it will do the work usually cheaper than by any other method, provided there is enough material to be handled to pay for the cost of moving it onto the job. A $\frac{3}{4}$ -yard or $\frac{1}{2}$ -yard shovel of the revolving type mounted on a four-wheel truck is a machine especially adaptable for highway work. A steam shovel, being a fast loader, not only cuts the cost of loading, but eliminates lost time of teams and trucks in waiting to be loaded. Some hand work is necessary behind the shovel to true up the grade and trim the slopes; the amount of hand work to be done will vary considerably, depending upon the skill of the shovel operator.

There are certain limitations in using a shovel, however. A shovel makes its largest outputs against a high face where it can dig without having to move ahead frequently.

In skim work or cuts under 8 inches in depth it would hardly be advisable to use a shovel. Where such cuts occur on the job, it is better to skip them and put the shovel into the work it can do to better advantage. A contractor who has several jobs under construction can by proper planning save work for the shovel on the different jobs, and by moving the shovel from one job to another derive a lot of benefit from one shovel.

In light trench work 8 inches and under, a bucket elevator loader may be used to advantage, if the material is free from large boulders and not too wet. There are several bucket loaders on the market which are driven by a gasoline motor and are essentially the same in their operation. Self-propulsion in these machines the writer believes to be a prerequisite for highway work. Some of the makes are equipped with a self-feed attachment, one of the most practical being a revolving shaft set at right angles to the bucket line, carrying paddle blades which work the material to be loaded toward the buckets.

There is one machine which is popular with some contractors for shallow grading. It is of the boom and bucket type, similar to the steam shovel, except that the bucket has a travel of several feet parallel to the grade of the road. While this machine will do good work in shallow trench work, it cannot compare with the steam shovel in heavy work, either for speed or performance.

Loading Equipment

On jobs which require the shipment of stone in railroad cars, the method of unloading them has to be considered. If a coal trestle can be found near the work, it is usually possible to make an arrangement with the owner for use of the trestle, so that cars can be unloaded from it. Stone cars with some form of bottom dump are necessary to work such a proposition advantageously, but they can usually be obtained without trouble. If a coal pocket can be obtained in conjunction with the trestle so that the stone can be run from the cars into the wagon or trucks which are to take it to the work, it makes an ideal loading method and one of the cheapest. If no pocket is to be had, a hopper may be built sometimes under the trestle at small expense, which will give practically the same results as the pocket.

A similar scheme can be worked out sometimes where a siding runs along the top of a bank with a road paralleling the siding at the foot of the bank. A hopper built at the top of the bank below the bottom of the cars and connected to the road level by means of a chute will make it possible to load conveyances on the road level in a rapid manner. Considerable difference in elevation is necessary to work this scheme, as stone will not readily run in a chute unless the drop is at least 12 inches to the foot. A considerable saving over unloading by hand can be made if stone is dropped from the cars into storage piles underneath the trestle and then reloaded into wagons or trucks by means of a steam shovel, or other mechanical loader. There are several makes of loaders similar to the machine described in a previous paragraph which will load from stock piles economically and rapidly.

A low-priced machine also suitable for such kind of work is a small belt conveyor driven by a gasoline engine. This machine is mounted on a two-wheel truck, is light, and can be easily moved. Sufficient elevation can be obtained so as to load into trucks. It is necessary to feed material to the belt by hand, and the output of the machine is governed largely by the rapidity with which the feeding is accomplished.

A belt conveyor will not load as cheaply as some of the self-feeding loaders previously mentioned, but it will considerably reduce the cost of doing the work by hand alone. A hoist with a clam-shell bucket may be used to load from stock-piles, or out of the cars direct. Many of the steam shovels are now built so that a clam-shell can be operated from the shovel boom. If a clam-shell is used, it is necessary to use some hand labor in the cars to trim the stone away from the sides and ends of the car, so that the bucket can reach it.

Another outfit which will unload stone direct from the cars is the bin and elevator. One of the best arrangements of this type consists of a 50-ton knockdown bin and a bucket elevator, shown on page 45. A narrow chute is built under the track with a gate in the lower end of it that allows the stone to drop into the buckets at any desired rate. The stone is elevated into the storage bin and can be loaded into wagons or trucks from the bin by gravity. A gas engine or electric motor provides power for the elevator.

The storage bin offers advantages: it provides a small reserve supply of material; the process of unloading and the method of hauling do not have to be so carefully coördinated; in the event of a breakdown in the loading equipment, a supply of material is available while the necessary repairs are being made; demurrage on cars is largely eliminated; and it is sometimes possible to obtain a greater output with less hauling equipment. The stone must be shipped in bottom-dump cars and is unloaded by dumping a pocket of a car over the chute underneath the track, thus allowing the stone to flow to the bucket

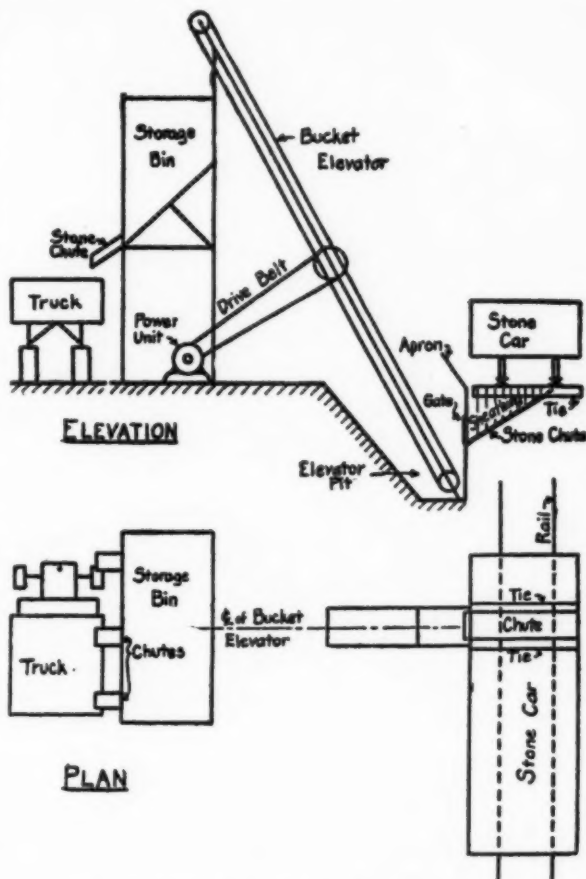
line. Considerable room is required to operate an outfit of this kind successfully. Sufficient length of track must be had so the cars can be pushed down by the chute; and as the side of the storage bin on which the trucks are loaded is about 26 feet from the rail, a width from the track of about 35 feet will be occupied in loading. If the right kind of stone cars can be obtained, this outfit will unload stone very cheaply and usually much faster than it can be drawn away economically. Two live men about the plant to look after the engine and move the cars are usually all the labor needed.

Hauling Equipment

The method of hauling to adopt depends largely upon the relation between the length of haul and the quantity of material to be moved daily. In excavating, teams are frequently the only means of hauling that can be used, the going is so difficult. If a steam shovel is used and proper footing can be had so a truck can make headway, dump trucks will be found to be the most eco-

nomical, particularly if the haul is long. Motor trucks, if they can be loaded quickly and can be kept moving without getting mired, make a very cheap method of hauling. Under these conditions a 5-ton truck will make from 60 to 90 miles a day. For extremely long hauls the truck is the only method to consider, and in certain instances a truck hauling from a permanent quarry to the job will be far cheaper than taking the stone by rail, unloading it and hauling it to the job from the nearest railroad point.

Hauling stone, bituminous pavement mixtures, bituminous material from central plants to work thirty and more miles distant are common occurrences in highway



PLAN AND ELEVATION OF METHOD FOR UNLOADING
STONE CARS



THE DEPTH OF THE LAYER OF ASPHALT IS REGULATED BY THE DRIVER

work. The 5-ton truck is the size most commonly used, and experience on work seems to warrant this choice. Where the process of loading is slow and the haul is not too long, the load may be placed in trailers for the truck to haul, the truck itself being without load.

Such a scheme has been used in connection with the delivery of hot pavement mixtures from a portable plant having a capacity of about 1,000 square yards of 2-inch surfacing material a day. The hot mixture was mixed in 500-pound batches at the rate of a batch every one-and-one-half minutes. Wagons built especially for hot mix work and equipped with short poles were used to receive the mix. Ten batches were dropped in a wagon, and two wagon loads, or 5 tons, were considered a load for the truck. While the truck was hauling these wagons to the point where the mixture was being placed, other wagons were being loaded at the plant awaiting the truck's return. As it would take thirty minutes to load the two wagons, sufficient trucks and wagons were provided according to the length of haul, so that the plant could mix continuously. On good roads without grade, the truck could handle the two trailer wagons nicely.

The principal advantage of the above method is that fewer trucks are required to do the work than if the mixture was loaded directly into the trucks. One-ton trucks have also been used to advantage in the delivery of hot mix material on short hauls.

For instance, with the mixing plant mentioned above, for an average mile haul three 1-ton trucks would be required to take care of the output, against two 5-ton trucks for the same condition. The cost of the three small trucks would be less than the two large ones, and fewer men would be needed to spread the mix hauled by the small trucks, since the smaller loads could be dumped nearer the point where the mixture was raked out than would be the case with the large loads.

Moving material by means of a train of wagons hauled by a steam roller or steam

tractor is the cheapest method of hauling, if the conditions are favorable for such a method. Steam traction is slow of movement, a speed of two to three miles an hour being possible. The fact that loads of from 15 to 30 tons can be drawn offsets this slow speed. The size of the load is governed by the condition of the road surface and the steepness of the grades. For hauls of one or two miles in length and fairly level grades, one roller can sometimes deliver material sufficient for the requirements of the work. Ordinary bottom-dump wagons equipped with short poles may be used in the train, but double-ended reversible hauling wagons built especially for this kind of work are more convenient, as the train can be hauled from either end. The double-ended wagons are also arranged to spread the load better than the ordinary dump-wagon.

If a three-wheel roller is used for traction it will overcome bad conditions of road surfaces more readily if a split wheel is substituted for the front wheel ordinarily used in rolling. While a steam traction engine is usually more powerful than a roller, it cannot be used except for hauling and is a piece of plant that is frequently idle if the right hauling condition for its use cannot be found. A traction engine generally does more damage to a road surface over which it travels than a roller, which fact would prohibit its use in some places.

There are many makes of gasoline trac-

tors, of all sizes from small to large; in fact, some three-wheel rollers are built with a gasoline motor. The small gasoline tractor may be used for hauling loads in exceptional instances and be worth while. Of the several types with which the writer is familiar, the tractors with traction tread seem to be best suited for conditions where

such machines might be used. A small tractor of this kind will overcome most difficult hauling conditions, and an excellent place for its use would be in hauling stone from the near-by fields to the crusher, particularly when the fields were in a wet condition from recent rains.

(To be continued in the May issue.)



LIGHT-WEIGHT TRACTOR HAULING WAGON IN ROAD GRADING

A Difficult Submarine Pipe Job

**Cast Iron Pipe Laid Water-tight Carries High-Voltage Electric Cables
Under River Channel at Bridgeport, Conn.**

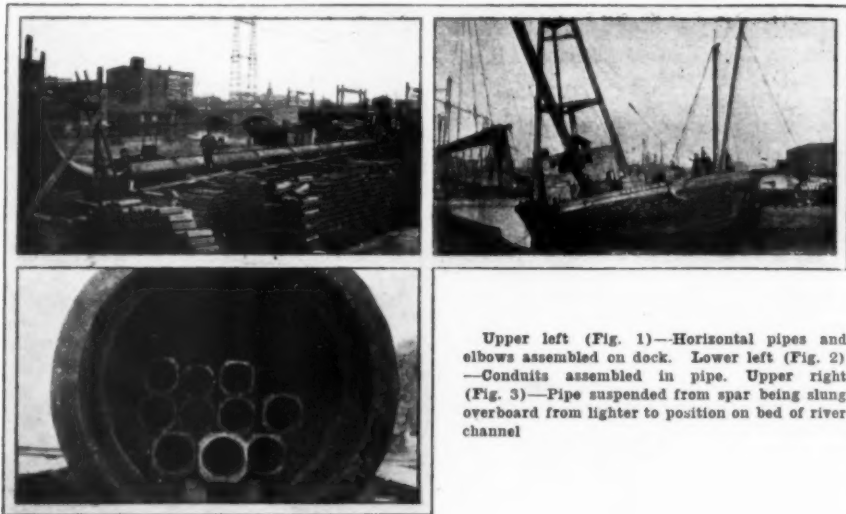
By S. E. Bittner

Engineer, T. A. Scott Company, Inc., New London, Conn.

IN order to protect the high-voltage electric cables of the United Illuminating Company, Bridgeport, Conn., which carry power across the river channel, this company installed a submarine pipe in which were carried the fibre conduits through which the high-voltage cables were run. The method of carrying the cables makes it easy to install or remove new or old cables as occasion requires. H. J. Leavett, engineer of the United Illuminating Company,

consulted with the T. A. Scott Company, Inc., of Boston and New London, Conn., regarding various schemes for carrying through this project. Finally the contract was awarded to this company to install a 24-inch cast iron bell-and-spigot pipe with 14 lines of 3-inch vitrified electric conduits installed therein.

Special elbows of 12-foot radius connected the horizontal and vertical sections of the submarine line, making it possible to



Upper left (Fig. 1)—Horizontal pipes and elbows assembled on dock. Lower left (Fig. 2)—Conduits assembled in pipe. Upper right (Fig. 3)—Pipe suspended from spar being slung overboard from lighter to position on bed of river channel

draw the $2\frac{3}{4}$ -inch-diameter, lead-covered, high-voltage cables through the conduits without difficulty.

The distance between the vertical pipes is 118 feet, and each of the risers is itself 40 feet long. The top of the horizontal pipe is laid 23 feet below water in order to clear all vessels using the channel at every stage of the tide. A pile foundation was built in the river-bed to receive the pipe, special pains being taken to secure a level bed. The horizontal pipes and elbows were assembled on a level foundation of the dock along the water-front, as shown in Figure 1. The conduits were installed in the pipe as it was assembled, the space between them being filled with concrete, as shown in the detail photograph, Figure 2.

After assembly, the pipe was closed at the end and tested with air pressure and also by vacuum, to be sure that it would be water-tight. When the section was proved to be water-tight, it was lifted by a lighter and placed on the prepared foundation. The section as lifted from the dock weighed 55 tons. In order to avoid any possibility of the line's breaking while being handled, the connected pipe was suspended at eleven points from a 24-inch spar, 114 feet long, by chains adjusted with turn-buckles, as shown in Figure 3. The spar

and pipe was suspended from the lighter boom at five points by means of cables brought to a common ring. In order to make it possible to release the spar from the pipe when the latter was in position, the spar was weighted down with six tons of chain to overcome its buoyancy. As soon as the lighter had lifted the pipe from the dock, it was hauled to the site and the pipe lowered into place.

After the horizontal sections and elbows were in place, the vertical sections were made up and put in place, the joints at the elbows being made under water by a diver. Fibre conduits were installed in the vertical sections after the pipe was in place. Foundations for cable houses were built around the vertical sections of the pipe. These houses are of stucco with tile roof to match the adjacent bridge. Conduits were built, connecting the cable houses with the bridge, as soon as feasible.

The installation is entirely successful, as the United Illuminating Company has found that $2\frac{3}{4}$ -inch Okonite lead-covered cables can be inserted or removed as readily from this submarine pipe as from ordinary street conduits and the line has proved to be absolutely dry, a feature which was aimed at and is most desirable for electric lines under all conditions.

Purchase and Erection of Engineering Equipment

Part II

A. S. Loizeaux

Electrical Engineer, Consolidated Gas, Electric Light and Power Company, Baltimore

Contracts to Cover Price, Terms of Payment, Time and Point of Delivery, Erection and Initial Operation

AFTER specifications have been evolved, as described in Section 3, it is necessary to enter into contracts for the different parts of the work to cover price, terms of payment, place and time of delivery, provisions for erection, initial operation and tests of equipment.

Contract forms are nearly always provided by manufacturers, with clauses protecting them from numerous possible contingencies. The owner's engineer should scan these carefully and eliminate or modify any that may be unsatisfactory or unfair to the owner.

Tabulation of Bids.—A valuable method which may be used to compare all important competitive bids is the method of tabulation. In tabulating bids parallel columns are provided, headed by different makes of apparatus available. The character of apparatus, with all its important features, method of control, operating characteristics, capacities, speeds, sizes, weights, materials, etc., are tabulated in these parallel columns. This method of analysis enables differences to be quickly and accurately located. It discloses what is the better of two or more propositions and enables the best proposition to be improved by requiring changes in the specifications submitted to provide for any superior features that may appear in any of the other specifications. By this means of comparison and selection remarkable results are sometimes obtained in procuring apparatus of high reliability and general efficiency.

Two examples of tabulated specifications are given herewith (Figures 1 and 2) to illustrate the method used. These tabulations do not apply to the coaling tower in question, but cover several types of equipment that are commonly met with, and may prove valuable as a guide in your future experience.

Price and Terms of Payment.—Price is a matter of competition with due regard to difference in material and equipment furnished. It is well to have inquiries, for prices contain a statement that the owner reserves the right to reject any or all of the bids submitted. The experience and reputation of the contracting firm must be considered and price difference allowed in favor of a concern of ample responsibility to meet emergencies that may arise, or bear losses that may occur. In terms of payment it is customary to allow 40 or 50 per cent on submission of bills of lading proving shipment. Contractors will usually call for two additional payments, one at 30 days and one at 60 days after shipment. These terms are in general not satisfactory to the owner except in the case of standard equipment. It is necessary for the protection of the owner's interest, when equipment is at all special, to provide a final payment of 25 per cent or more after complete erection and satisfactory operation of the apparatus. This safeguards the owner from carelessness on the manufacturer's or contractor's part in not putting equipment in final and satisfactory operating shape, and provides the owner with a whip to require the full performance of the terms of the specifications and contract.

Point of delivery should be carefully specified, as many troublesome delays are due to lack of full information as to this matter.

Erection is best placed with the same concern that provides structure or equipment as before noted. If for good reasons it must be given to separate concerns, it is necessary to carefully specify how and where the material is to be delivered, who shall unload it and move it to the permanent site. It is necessary to state what responsibility shall be taken by the erector and what by the manufacturer or owner. Insurance is generally necessary to cover accident during erection, and it should be

stated that defects of erection shall be made good without loss to the owner.

It is necessary to specify conditions governing overtime in erection. These additional expenses can be placed on the manufacturer if delivery is late, but only when so specified.

Extra work must be mentioned, giving terms and rates at which such work shall be done.

Actual operation is the final test of all equipment, and considerable periods of time should elapse whenever possible before final payments are made, as it is possible for radical defects to develop after a short period of successful operation. The owner's engineer must be careful not to commit himself in word or writing as to his final acceptance of equipment until the latter has been in full capacity operation for a considerable period.

Contracts on Basis of Cost.—There are some situations when it is desirable to enter into a contract on the basis of the cost of the work to the contractor.

Such a situation exists when the cost is doubtful because of unknown conditions of soil for foundations, unknown conditions of stream flow or weather, or the like, which may greatly influence the cost. The risk in such cases belongs to the owner, not to the contractor. The contractor could not take this risk unless he included a high figure for

contingencies in his bid or gambled on his chances of good luck in construction.

A contract based on cost must define cost carefully, stating particularly what per cent is to be charged for overhead costs, or whether the overhead is to be included in a per cent to cover profit as well.

Plant.—In contracts for field work the cost of plant must be explicitly stated. It is generally to the owner's interest to agree on a flat sum to cover all plant rental, specifying, however, the main items of plant that may be required. This makes it to the contractor's interest to finish the job promptly, to use his plant elsewhere.

After paying all costs, including overhead, it is common to allow the contractor a net profit of 5, 10 or 15 per cent, depending on conditions and the magnitude of the work. Another method, however, which has an important advantage, is to give the contractor a fixed fee for his services over and above his costs, including overhead. This also tends to expedite the work, as the contractor cannot increase his fee by delays or increased costs.

Following Up Manufacture, Delivery and Erection

After contracts have been signed embodying all specifications, it might be supposed by the engineering student that the engineer's work was finished, but such is far from the fact. To obtain what we have

TABULATION OF BIDS CENTRIFUGAL PUMP TWO STAGE, VOLUTE TYPE, 1000 G.P.M. 280'-HEAD						
MANUFACTURER				SUMMARY		
	MAKE I	MAKE II	MAKE III	MAKE I	MAKE II	MAKE III
R.P.M.	1750	1750	1750	⊙	⊙	⊙
Eff at 1/2 load-%	58	53	55	⊙		
Power req at 1/2 load BHP	70	93	90	⊙		
Eff at full load-%	70	63.5	64	⊙		
Power req at full load BHP	100	111.2	110	⊙		
Impeller	Bronze	Bronze	Bronze	⊙	⊙	⊙
Thrust Bearing	None	None	None	⊙	⊙	⊙
Bearing Lubrication	Ring	Ring	Ring	⊙	⊙	⊙
Suction Size	8"	8"	6"	⊙	⊙	
Discharge Size	6"	6"	6"	⊙	⊙	
Weight	4100#	4000#	3800#	⊙		
Delivery	6 mo.	8 mo.	4 mo.			⊙
Price	\$911.00	\$1200.00	\$1100.00	⊙		
SELECTED						
Note—⊙ Indicates Favorable Characteristic Curves Attached						

FIGURE 1

TABULATION OF BIDS 500 K.W. TURBINE DRIVEN EXCITER 115 VOLTS - 2400 AMPERES				
MANUFACTURER	MAKE I	MAKE II	MAKE III	REMARKS
Turbine speed [RPM]	6000	4000	3600	② ③
No. of stages	1	2	6	② ③
No. of rows of moving buckets	2	4	2	② ③
Material of buckets	Nickel Steel	Monel Metal	Special Bronze	②
Bucket fastening	Curtiss	Pin Wedge	Special	② ③
Bucket top speed [ft/sec]	600	480	390	② ③
Water rate	38	42	45	②
Packing	Water Seal	Carbon	Soft & Labyrinth	② ③
Generator make				
Speed [RPM]	750	1000	1200	② ③
Type				
Gear ratio	8 to 1	4 to 1	3 to 1	② ③
Oil pump	Gear Pump On Gov. Shaft	Slow Speed Gear	None	②
Lubrication of Gears	Forced	Forced	Splash	② ③
Governor	High Speed Vertical	High Speed Horiz	Slow Speed Vertical	②
Weight of Unit	16,500 ^{lb}	20,000 ^{lb}	19,000 ^{lb}	②
Delivery	5 Months	4 Months	2 1/2 Months	②
Price	\$110,000 ⁰⁰	\$10,000 ⁰⁰	\$10,500 ⁰⁰	②
Note - ② Indicates Favorable Characteristic Make II Selected				

FIGURE 2

specified at the right time usually requires a large amount of effort in following up the various manufacturers and construction men.

In all important equipment where time has a large financial value, it is wise, and often necessary, to have a follow-up system, keeping track of the progress of manufacture, especially of the heavier parts, such as large forgings and castings, to insure that delivery will not be greatly delayed. It is the customer who follows his work the closest and inquires most persistently and explicitly of the manufacturer that gets the best service from the factory. A trip to the factory to see the exact status is often necessary and profitable.

Progress Schedules.—An effective means of securing results in deliveries and erection is the formation of a tabulated schedule specifying all of the important parts of a completed job at the side of the tabulation and making spaces showing time intervals at the top of the tabulation, as indicated in figure 3. The desired progress of the work can then be charted from the beginning of the manufacture or field work to the completion of the job. Actual progress can be checked up continuously, at least every week, comparing it with the chart and noting actual progress on the chart. In this way, if the chart has been made with a sound, practical knowledge of methods and conditions, we can avoid or minimize delays

by immediately spurring up the field work or delivery of material and equipment as may be necessary, to promote the steady and satisfactory progress of the work as a whole.

Inspection of Structural Steel.—Certain firms make a business of inspecting structural steel in the rolling mill and the fabricating shop and during erection in the field. It is often desirable for an owner to contract for such inspection, as its cost is low, 50 cents to \$1 per ton, and besides eliminating the chance of inferior material and workmanship, it sometimes avoids delays in shipment. It is also useful to have an inspector on the field work to settle disputes that arise during erection.

Erection.—The foreman in charge of erection decidedly influences the speed and quality of the work. When an unusually capable foreman is known, his services may be called for by the owner with good results. A foreman should have support in getting labor and material, and in some cases where time is valuable, he may be given a bonus for completion earlier than the normal time for erection.

Completion is often specified in number of working days rather than by definite date. This is justified for outdoor construction, especially in winter, when the contractor is prevented by the weather from making progress on certain days.

Operation of Equipment.—As before stated, the final determination of whether contract has been met is found in the results of operation. It should be understood, however, that initial operation may not be entirely satisfactory. In many cases adjustments and improvements are necessary, wrinkles must be smoothed out and the equipment groomed for its best performance.

Operation is not only a test of whether specification has been met, but is also a gage of the engineer's success in obtaining desirable features which are not or cannot be included in specification. For instance, such qualities as quietness of operation, freedom from vibration, rigidity of structure, convenience and ease of control, are not generally subject to specifications in any exact terms, yet they indicate the degree of skill with which the design has been made and carried out.

The coaling towers in question are a success from the standpoint of operation. The towers are rigid and the hoists not only do more than their guaranteed capacity, but they perform more smoothly than is com-

mon. The writer has been in steam-operated towers that swayed and groaned in operation like a ship in a heavy sea, due in part to vibration of the reciprocating engine. The electric drive, while producing very heavy torque, is smooth in action.

Purchasing Department.—In companies having a purchasing department the engineer works through such department in most of his official acts, such as the invitation to bid or the awarding of a contract. Engineering interviews are a part of the engineer's duties to arrive at correct decisions, the final results of his work in the form of specifications and orders or contracts being sent through the purchasing department and company's officials to maintain uniform records and secure proper approval of important purchases.

A. I. E. E. Standardization Rules.—The purchase of electrical machines has been simplified by the issuance some years ago of the Standardization Rules of the American Institute of Electrical Engineers which specify standard temperatures, etc.

Acknowledgment:—Reprinted from the J. E. Aldred lectures of 1920, Johns Hopkins University, Baltimore, Md.

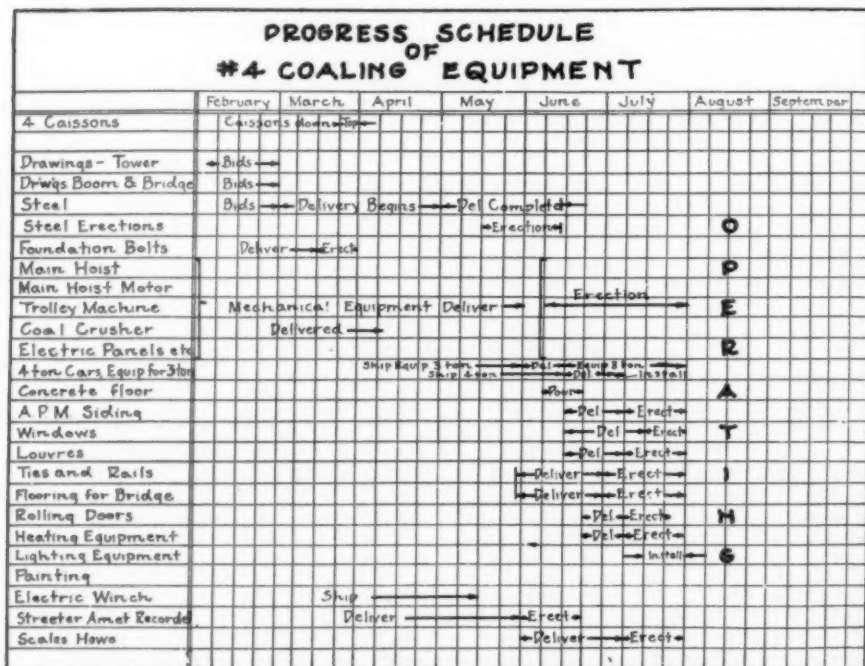


FIGURE 3

DATA FOR YOUR DESK FILES.....

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

REVOLVING STEAM SHOVELS.

The Bucyrus 14 B revolving steam shovel, made by the Bucyrus Company, South Milwaukee, Wis., is described in detail in Bulletin G-G, which may be secured on request.

ALL-STEEL CONCRETE MIXER.

Bulletin No. 10 C-E, issued by the Gray Iron Foundry Co., Reading, Pa., describes in detail the Keystone all-steel mixers, which produce a thoroughly mixed batch in 30 seconds and discharge the entire batch in 12 to 18 seconds.

METERS THAT STAND THE TEST.

If you are interested in a sturdy water meter built to last and priced right, send for the literature of the Gamon Meter Co., Newark, N. J.

HEAVY CHEMICALS FOR WATER-WORKS.

Price quotations on sulphate of alumina, chloride of lime and liquid chlorine for water treatment and sterilization may be secured from the Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

INDUSTRIAL PIPING EQUIPMENT.

Full data regarding piping for automatic sprinkler systems, compressed steam, hot water and gas, circulating systems, etc., may be secured from the Grinnell Co., Providence, R. I.

IMPROVED ASPHALTIC CONCRETE PAVEMENTS.

Complete information regarding Bitoslag, an improved asphaltic concrete pavement, may be secured by writing for the latest booklet published by the Bitoslag Paving Co., 90 West St., New York.

METER FRAMES FOR SETTING WATER METERS.

A request sent to the Ford Meter Box Co., 406 South Carroll St., Wabash, Ind., for information regarding Ford Rams Horn meter frames for mounting meters in cellars in a quick and handy manner, will bring you full literature describing them.

GASOLINE INDUSTRIAL LOCOMOTIVES.

Illustrated literature regarding the advantages of Cummings gasoline locomotives for road work and general contracting, requiring the use of an industrial railway, may be secured from Herbert Crapster, Sales Manager, The Cummings Machine Co., 1 Madison Ave., New York City.

PIPE TAPPING MACHINES.

Literature describing Payne's patent New Eclipse tapping machines for use on water mains may be secured from the Hays Mfg. Co., Erie, Pa.

CONTRACTORS' WAGONS.

Bulletin 110, published by the Acme Road Machinery Co., Frankfort, N. Y., contains information regarding Cook's Frankfort wagons and carts, Acme low-gear trucks, ash wagons, garbage wagons, Acme train wagons, Acme street sweepers, sprinklers and tank wagons.

EVERYTHING FOR FIRE FIGHTING.

The American-LaFrance Fire Engine Co., Elmira, N. Y., manufactures not only the standard type of fire apparatus but also hand equipment and miscellaneous fire department supplies.

COMBINATION DUMP-BODIES FOR TRUCKS.

The Heil Co., 1243 26th Ave., Milwaukee, Wis., in its Price List BH 121 gives information regarding Heil hydrohoists and dump bodies for all types of service.

TRUCKS FOR CONTRACTORS.

In an illustrated folder entitled "Making Good for Contractors," The Federal Motor Truck Company, 34 Federal Ave., Detroit, Mich., gives details regarding the points of Federal trucks which will be of particular interest to contractors.

LOCOMOTIVE CRANES.

In a well-arranged 48-page illustrated catalog, "B," the Browning Co., Cleveland, O., describes its locomotive cranes. The photographs show their various uses by contractors in all parts of the United States.

LIFTING-JACKS FOR EVERY PURPOSE.

The new 148-page Duff catalog, illustrating and describing all types of jacks for all kinds of work, may be secured by writing to the Duff Mfg. Co., 520 Preble Ave., Pittsburgh, Pa.

TANK-FRAME INDUSTRIAL LOCOMOTIVES.

Record No. 94, published by the Baldwin Locomotive Works, Philadelphia, Pa., describes in detail this type of industrial locomotive for contracting work.

EQUIPMENT FOR ROAD BUILDERS.

In a 48-page catalog, No. 22 M, the Galion Iron Works & Mfg. Co., Galion, Ohio, describes in detail its complete line of cast iron culvert pipe, graders, scarifiers, gravel screening plants, scrapers and drags, road plows and tractors.

THE TRACTOR IN ROAD BUILDING.

The literature of the Cleveland Tractor Co., 19211 Euclid Ave., Cleveland, Ohio, contains interesting and valuable information for road builders regarding the use of tractors in heavy hauling.

STEAM AND MOTOR ROAD ROLLERS.

Steam and motor rollers with and without scarifier attachments are described in detail with specifications and illustrations in catalog A, which may be secured from the Buffalo Springfield Roller Co., Springfield, Ohio.

DRAINAGE EXCAVATORS AND DITCHERS.

The Austin ditcher with bank-sloping attachment is described in detail in an interesting 8-page booklet which may be secured from the Austin Machinery Corp., 609 Railway Exchange Bldg., Chicago, Ill.

MOTOR TRUCKS FOR ROAD BUILDERS.

Full information regarding the uses of GMC trucks for road builders and general contracting is given in the special road-building circulars issued by the General Motors Truck Co., Pontiac, Mich.

REVERSIBLE RATCHET WRENCHES.

Complete information regarding "Favorite" reversible ratchet wrenches may be secured by writing to Greene, Tweed & Co., 109 Duane St., New York City.

DUMP BUCKETS AND WHEELBARROWS.

Catalog No. 75, issued by the G. L. Steubner Iron Works, Vernon Ave. & Twelfth St., Long Island City, N. Y., contains data regarding the self-dumping and self-righting buckets and side-dumping tip cars and iron tray wheelbarrows manufactured by this company.

CONCRETE MIXERS FOR CURB AND GUTTER.

The Wonder mixer, manufactured by F. H. Conklin & W. G. Harrington, Room 1762, 50 Church St., New York City, and described in literature which may be secured from this company, is built in four sizes, is readily portable, and valuable for curb and gutter work and for cold patch mixing.

HEAVY-DUTY CONCRETE MIXERS.

Catalogs C-6, P-6 and D-6 describe the heavy-duty steam and gasoline mixers, paving mixers and Dandle light mixers, respectively, made by the Koehring Machine Co., Milwaukee, Wis.

RAILWAYS FOR ROAD BUILDING.

In Catalog 100 N, the Koppel Industrial Car & Equipment Co., Koppel, Pa., gives full data regarding modern and efficient hauling systems for use in the construction of public highways.

SUCCESSFUL WATER METERS.

Meters that have met the test of serving customers satisfactorily under all kinds of conditions are described in the latest literature of the Neptune Meter Co., 50 East 42nd St., New York City.

PILE-DRIVING MACHINERY

Catalog 4 M, containing illustrated material and data on pile hammers and pile-driving machinery, may be secured from W. G. Schalscha, Union Iron Works, Hoboken, N. J.

TRAILERS FOR HIGHWAY WORK.

The Highway Trailer Co., Edgerton, Wis., has prepared several interesting folders and bulletins describing the uses of 4-wheel, high-speed, heavy-duty, reversible trailers by contractors and municipal departments.

REINFORCING CONCRETE ROADS.

The American Steel & Wire Co., Chicago, Ill., has published an illustrated booklet on concrete road construction which will be of interest and value to highway contractors. It contains tables, weights and other data useful in figuring highway contracts.

STEAM SHOVEL SERVICE.

From the Marion Steam Shovel Co., Marion, O., in catalog 188, you can secure data on steam shovels, drag-lines and small revolving shovels, with illustrations, showing them in service.

TRENCH PUMPS.

The No. 3 contractors' pump, which is a fine trench pump, a powerful force pump, and an odorless excavator, is described in literature which may be secured from A. A. Parker, Watford, N. Y.

TRENCH EXCAVATORS.

The Buckeye Traction Ditcher Co., Findlay, O., in its catalog, "Buckeye Trench Excavators," gives illustrations and data and shows the varied uses of this type of trench excavator.

MIXERS MOVED BY ONE MAN.

Booklet No. 32, which may be secured on request from the Archer Iron Works, Chicago, Ill., describes Archer concrete mixers which have end discharge and which may be readily moved by one man.

WIRE ROPE FOR EVERY PURPOSE.

The Hazard Mfg. Co., Wilkes-Barre, Pa., has published in its price list No. 18, interesting details regarding the sizes, weights and breaking strength of various types of wire rope.

WINDOW SASH FOR BUILDINGS.

In catalog Section 1, the Detroit Steel Products Co., Detroit, Mich., describes in detail its Fenestra steel side-wall sashes for various types of structures.

ROAD-DIGGING STEAM SHOVELS.

Full information regarding the use of steam shovels in highway and railroad excavation will be found in Bulletin No. 30, which may be secured from the Trew Shovel Co., Lorain, O.

WATER-PROOF WALL BOARD.

The Philip Carey Co., 9 Wayne Ave., Cincinnati, Ohio, in catalog 703 M, describes Carey Board, a water-proof wall board for convenient interior surfacing for buildings.

PRESSURE DISTRIBUTORS FOR BITUMINOUS MATERIALS.

The Cressy-Pillsbury patented sprayer for applying hot asphaltic materials under pressure for surfacing roads is described in a booklet which may be secured from the Cressy Road Sprayer Mfg. Co., 452-470 Second St., Everett, Mass.

AIR TOOLS.

Catalog No. 19 M, published by the Cleveland Pneumatic Tool Co., Cleveland, Ohio, contains detailed descriptions and outlines of the uses of Cleveland riveting hammers, chipping hammers, heading hammers, calking hammers, scaling hammers, bushing hammers, reversible drills, tapping machines, breast drills, compound drills, portable grinders, buffing machines, floor ramblers, valve grinders, etc.

CONTRACTORS' USED EQUIPMENT

The largest variety of contractors' used equipment for sale, rent or exchange is contained in the Searchlight Section of the Engineering News-Record. A copy will be sent free if you will address your request to Searchlight Dept., McGraw-Hill Co., 475 10th Ave., New York City.

HIGHWAY CONSTRUCTION WITH MOTOR TRUCKS.

The Autocar Company, Ardmore, Pa., has issued an interesting bulletin, "Highway Construction with Autocar Motor Trucks," which will be sent to any highway contractor or engineer on request.

A SMALL MOTOR ROAD MAINTAINER.

Full information regarding the Utilitor road maintainer, a small motor device that drags roads successfully at small cost, is described in the literature which may be secured from Division R 10, Midwest Engine Co., Indianapolis, Ind.

RECORDS OF CAST IRON PIPE.

The U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J., has just issued a folder regarding the use of cast iron pipe by the Albany, N. Y., waterworks in 1813, which will interest officials and contractors for water distribution systems.

MATERIAL HANDLING MACHINERY.

Catalog 296 of the Jeffrey Manufacturing Co., Columbus, O., contains a complete listing of Jeffrey material-handling machinery for all kinds of contracting work, including buckets and belt conveyors, roll crushers, V-bucket conveyors, steel apron conveyors, scraper conveyors, valves and chutes, bucket elevators, swing hammer pulverizers, car hauls, tray elevators, rigid arm elevators, fertilizer elevators, cable retarding conveyors, etc.

ASPHALT MIXING PLANTS.

Bulletin 2B, issued by the Iroquois Department, the Barber Asphalt Paving Co., Land Title Building, Philadelphia, Pa., contains complete descriptions of all types and sizes of Iroquois asphalt mixing plants, from the 800-gal-per-day portable two-unit plant to the 2,000-square-yard single-car railroad plant.

SMALL WATER-SUPPLY SYSTEMS.

Catalog D, which may be secured from the Deming Co., Salem, O., contains complete information regarding Deming hydro-pneumatic water-supply systems, and hand and power pumps for individual house installations or for small institutions.

TAR AND ASPHALT KETTLES.

Full data regarding portable and stationary tar and asphalt kettles will be found in the interesting illustrated catalog of the Joseph Honhorst Co., 1016 West 6th St., Cincinnati, O.

CLAM-SHELL BUCKETS THAT CLEAN UP THE JOE.

Owen clam-shell buckets, which have lubricated and grip-proof main bearings and which come through with a full load on every trip, are described in a booklet which may be secured from the Owen Bucket Co., 418 Kirby Bldg., Cleveland, O.

A FIREPROOFING HANDBOOK.

The General Fireproofing Co., Youngstown, O., has published an interesting 4-page book dealing with the problem of fire-proof construction, using as a basis the reinforcing material manufactured by this company.

ROAD BUILDING WITH TRACTORS.

In an illustrated folder entitled "Road Building the Best Way," the C. L. Best Tractor Co., San Leandro, Calif., gives interesting data regarding the use of Best tracklayer tractors for various types of road-building work.

SPEEDING LOADING FOR TRUCKS.

The Heltzel Steel Form & Iron Co., Warren, O., manufacturers of the Heltzel Lightning Loader for reducing the time necessary for loading motor trucks by hand from railway cars, will be glad to send literature describing the savings effected by this device.

SEGMENT BLOCKS FOR SEWER CONSTRUCTION.

The W. S. Dickey Clay Mfg. Co., Kansas City, Mo., will be glad to send to contractors its 48-page reference book on "Dickey Segment Blocks."

CONTRACTORS' MACHINERY.

Portable saw rigs, power pumps, compressors, builders' hoists, material elevators, and mortar mixers with gasoline or kerosene engines are described in the illustrated bulletin of the C. H. & E. Mfg. Co., Milwaukee, Wis.

CONTRACTORS', ENGINEERS' AND MANUFACTURERS' NOTES

New Vice-President for Barber-Greene

H. S. Greene, who for several years has been Assistant Sales Manager for the National Carbon Company, Cleveland, has been elected Vice-President in charge of sales for the Barber-Greene Company, Aurora, Ill.; Mr. Greene is a brother of W. B. Greene, Vice-President and Treasurer of the Barber-Greene Company, and has been a director of the company for some time.

Fire Will Not Handicap Austin Machinery Shipments

The fire at the Winthrop Harbor, Ill., plant of the Austin Machinery Corporation, on Tuesday night, March 22nd, while extensive, will not, according to officials of the corporation, in any way interfere with production and prompt delivery of Austin trenching machines, backfillers, building mixers, pavers, draglines and shovels, as practically all lines of Austin machinery are also being built at the plants at Muskegon, Mich., as well as at the former plant of the Toledo Bridge and Crane Company, at Toledo, Ohio.

Arrangements were immediately made at the Toledo and Muskegon plants to increase their stock production orders to take care of the shortage which would otherwise occur from the loss of the Winthrop Harbor plant. The fire at the latter plant completely destroyed the unfinished stock warehouse and storerooms, both the trenching machinery assembly and paving mixer assembly buildings, and a number of machines on which assembly was practically completed. But the fire did not reach the finished machines warehouses and, fortunately, a number of machines had just been loaded on cars for shipment and were saved.

The Austin Machinery Corporation advises that it has on hand in Muskegon and at Toledo ample stocks of wagon loaders, and the popular sizes of trenching machines, backfillers, mixers, pavers, and 1/2-yard and 3/4-yard draglines and shovels, and that a new lot of 1-yard shovels and draglines are now coming through the Toledo plant.

Wood Pipe Export Offices at San Francisco

The Wood Pipe Export Company, 523-524 White Building, Seattle, Wash., has opened a new office at 775-777 Monadnock Building, San Francisco, Calif., in order to avail itself of the export facilities afforded by San Francisco. Thus the company will be better able to serve all foreign purchasers of redwood and Douglas fir-wood pipe.

The George A. Johnson Co.

Johnson & Benham, Ltd., Consulting Engineers, of New York and Kansas City, Mo., announce the reorganization of the business. All contracts and business of the New York office have been taken over by George A. Johnson Company, Inc., the members thereof being George A. Johnson, Harold C. Stevens, Nelson B. Wolfe, Charles R. Wyckoff and Harry B. Joyce. The main offices of the corporation are at 150 Nassau Street, New York City. All contracts and business of the Kansas City office have been taken over by Benham & Mullergren, a partnership consisting of Webster L. Benham and Arthur L. Mullergren, with offices on the eighth floor of the Firestone Building, Kansas City, Mo.

The Death of Walter F. Deming

On March 19 Walter F. Deming, President of the Deming Company, Salem, Ohio, passed away. The original firm of Silver & Deming Manufacturing Company, which was founded in 1854, began the manufacture of pumps in 1880, six years after Mr. Deming's entrance into the business. In 1890, a division was made, the Deming Company taking over the pump business, so that practically all of Mr. Deming's life has been connected with the pump industry.

During his association with this business, Mr. Deming won not only the admiration of all with whom he came in contact, but their esteem as well for his high ideals of business practice.

Wallace and Tiernan Move

Owing to the steadily increasing growth and rapidly enlarging scope of the business of Wallace and Tiernan Company, Inc., formerly located at 349 Broadway, New York City, this company has moved to its new plant, Newark, N. J., where under one roof all the activities of its business will be conducted, including engineering, design, manufacture, assembling, testing and shipping, and all laboratory work, as well as the sales and executive supervision. The new mail address of Wallace and Tiernan is Box 178, Newark, N. J.

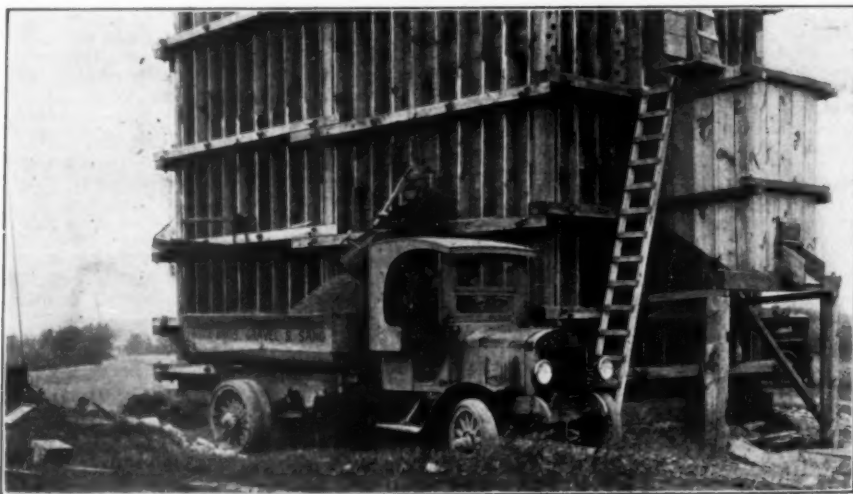
Wallace and Tiernan are manufacturers of chlorine control apparatus for the sterilization of water, sewage, tannery and other trade wastes, for the purification of swimming pools, for making bleaching solutions from liquid chlorine, largely used in bleaching paper and in the textile industry, and have developed a machine for deodorizing organic fumes in the waste-stacks of refining plants.

Motor Trucks and Machinery in Service

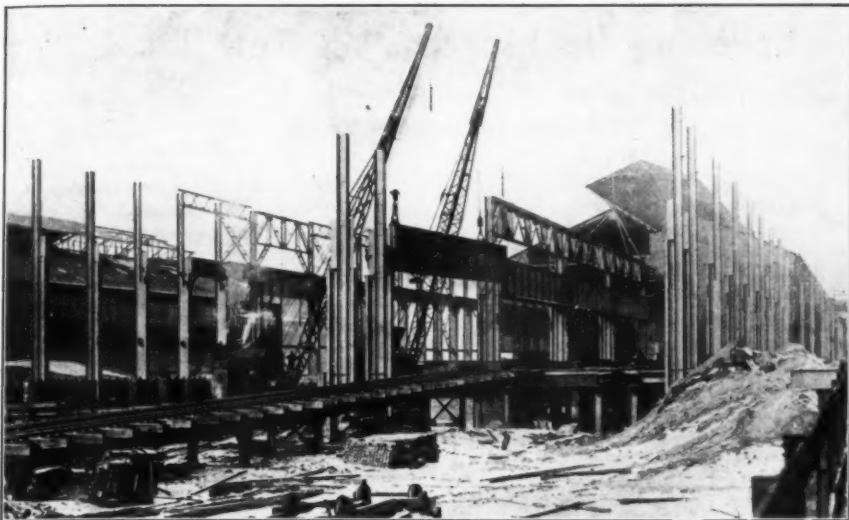


FEDERAL TRUCKS OWNED BY J. W. ROOKS, CONTRACTOR, McALESTER, OKLA., BEING LOADED FROM SPOIL PILE BY STEAM SHOVEL

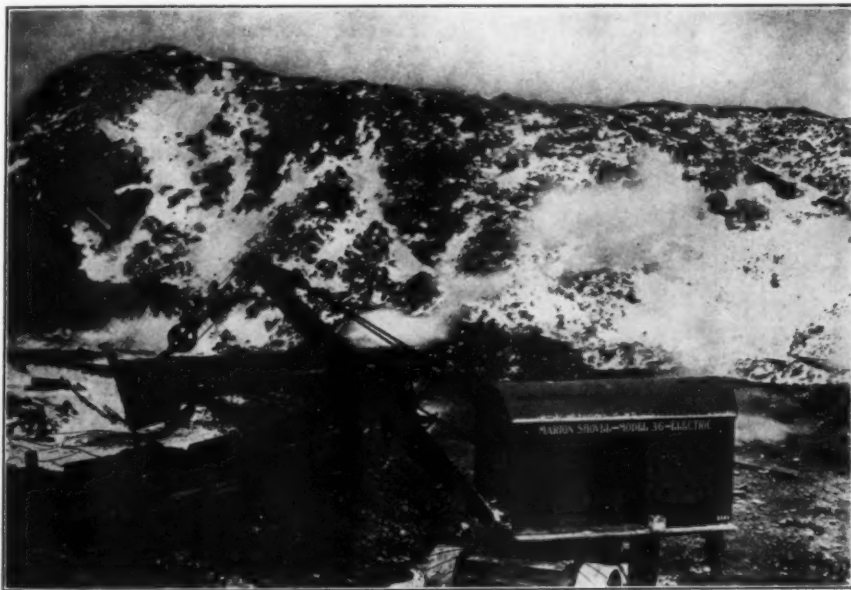
WE CAN'T ALWAYS TELL BY APPEARANCES: THE DERRICK IS AN UNSIGHTLY OBJECT, BUT IT HAS UPLIFTING INFLUENCES



A GMC TRUCK RECEIVING ITS LOAD OF SAND FOR QUICK HAULAGE TO THE SCENE OF BUILDING CONSTRUCTION



BROWNING LOCOMOTIVE CRANES HANDLING A 42-TON GIRDER FOR A FABRICATED STEEL BUILDING



A MARION SHOVEL EQUIPPED WITH GENERAL ELECTRIC MOTORS OPERATING ON A STRIPPING JOB

The electrical operation of shovels is practically limited to those localities where permanent electric power is readily available. Where such is the case it has been found economical and advantageous. The steam- or gasoline-operated shovel with traction tread will continue to hold its own in the bulk of contracting work because of its ability to travel unhindered by cable connections. Contractors should seriously consider the electric shovel, however, where long jobs are in prospect with cheap power available.

Speeding Up Progress on New Roads

Minneapolis Contractors Gain Time by Use of Well-balanced Equipment and Fleet of 2-Ton Motor Trucks

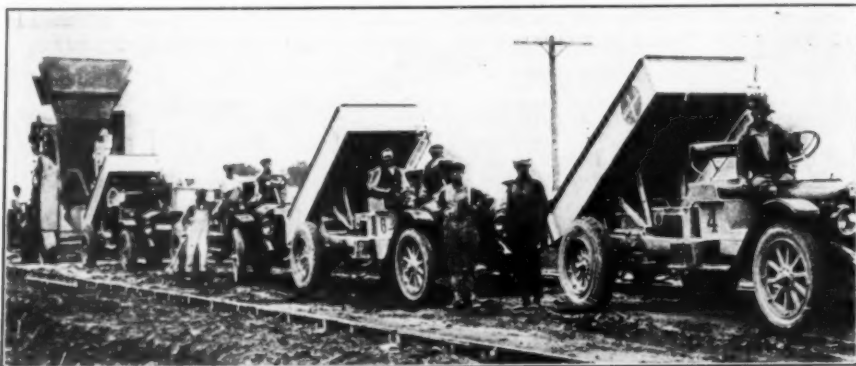
ON one 15-mile project, Johnson, Drake & Piper, road contractors, Minneapolis, Minn., poured 830 feet of 18-foot roadway in a day. On the same job, 600 feet per day was the average maintained for 2 weeks, 4 miles being the average length of haul for materials. Several hundred lineal feet of roadway were poured daily while another job lasted.

In each instance motor trucks were a big factor in enabling the contractors to accomplish the amount of work they did. Transportation of materials, Johnson, Drake

were divided into equal compartments.

In loading, each motor truck, stopping under the rock bin just long enough to shift gears, received two separate batches of rock in its twin compartments; moved ahead about 12 feet and received two separate batches of sand simultaneously; moved forward once more to receive the proper amounts of cement from another pair of chutes; and then started on its way to the mixer, the complete loading operation having consumed not over 2 minutes.

Traversing a $\frac{3}{4}$ -mile stretch of dirt road



PART OF THE DAY BROTHERS' FLEET OF 12 WHITE TRUCKS

& Piper consider, is one of the most important operations in road building; therefore the care exercised to systematize this end of their work.

Six 2-ton White trucks with power dumping bodies were used on one project, calling for $3\frac{1}{2}$ miles of new concrete highway. The trucks were operated by Day Brothers, of Minneapolis, who held a subcontract from Johnson, Drake & Piper.

The average haul from the central proportioning plant erected at the railroad siding was 3 miles. At the central proportioning plant a clam-shell derrick loaded cement, sand and rock into separate bins. From these bins the material was proportioned through chutes into measuring boxes. By means of center gates, the truck bodies

to reach the main highway, the trucks finally reached their destination at whatever point along the main road the mixer happened to be located. The next move, then, was to unload. Backing up to the skip with body in dumping position, each truck emptied one compartment. When the skip had hoisted the batch into the mixer, the trucks in turn dumped the remainder of their loads and were some distance away before the last batches were hoisted.

Each truck made 23 to 25 trips between the central proportioning plant and the mixer—an average 3-mile haul—in a 10-hour day. The 2-ton trucks, supplying a 3-sack mixer, facilitated the pouring of 700 lineal feet of 18-foot concrete roadway 7 inches thick.

An Improved Steam Stump Puller and Piler

A MACHINE has been developed by the Clyde Iron Works, Duluth, Minn., which combines the functions of dynamite, horse-driven stump pullers, teams and piling gangs, and which is able to do the work better, quicker and at a considerably smaller cost. The machine is designed to clear 5 acres at a single average set, an area approximately 600 feet wide by 350 feet deep, pulling all the stumps within the area, skidding them to a central pile, cleaning them and swinging them up onto the pile. After completely clearing one such tract, it moves under its own power into position to command a similar adjoining tract, which is in turn left free from all obstacles to agriculture or road building.

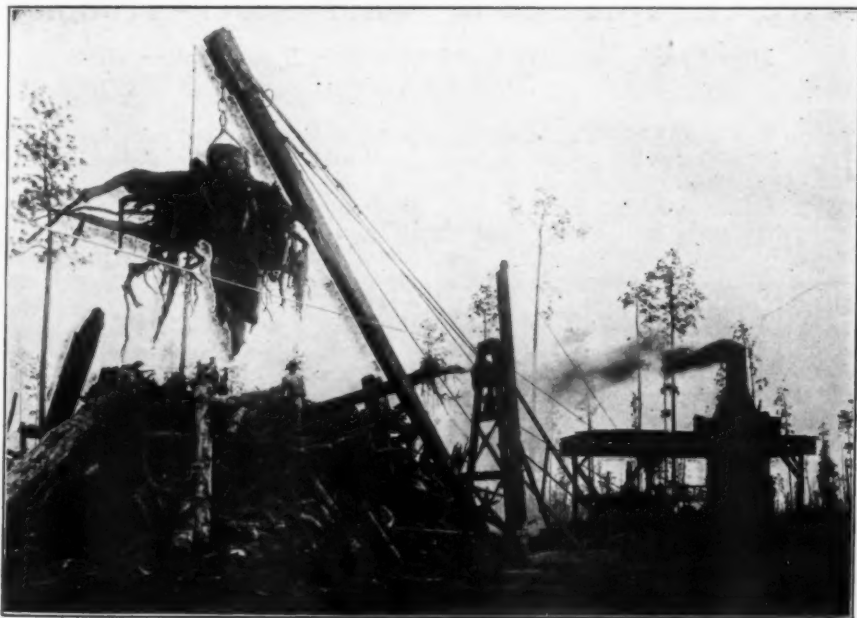
Manual labor is reduced to the minimum, practically the entire operation being completed by mechanical means. After the machine is in position, the men have only to hook on each stump and to handle the throttle and levers. The stump is pulled under steam power and brought in to the machine under steam power and piled by steam power, while the pulling cable is carried out to the pulling point again by a special outhaul cable operated by steam power.

Having been brought into a position commanding the land to be cleared, the machine is securely anchored by means of a crotch chain

or anchor cable, secured to stumps or trees in the rear or by driving steel spuds through slots provided for that purpose in the rear of the steel runners.

The outhaul cable, which is contained in the rear drum of the engine, is then taken out, passed through a block so placed as to enclose the area to be cleared, and returned to the machine, where it is made fast to the pulling cable. The outhaul drum is then thrown into gear winding up at the rate of 800 feet a minute and carrying the pulling cable at that speed out to the first stump to be pulled. A choker-line of proper size for the stumps to be handled, having a heavy, cast steel, wide-throated choker-hook spliced in one end and a long loop in the other, is used for attaching to the stump by passing around the stump and forming a slip noose with the choker-hook.

The loop is then slipped into a heavy hook on the end of a tag-line on the pulling cable. This tag-line is attached to the end of the pulling line by means of a swivel and clevis. The front drum, carrying the main pulling cable, is now engaged with high-speed friction, quickly pulling out the line taut, whereupon, without slacking the line, it is thrown into low gear, exerting a strain as required up to 145,000 pounds on the stump and pulling in at a line speed of thirty feet a minute.



PILING THE STUMPS AFTER CLEARING A FIELD WITH A CLYDE STUMP PULLER

Immediately after the stump comes up and out, the operator throws this pulling line drum into high gear, automatically releasing the low-speed clutch and bringing the stump into the machine at the rate of 350 feet a minute, cleaning off much of the dirt adhering to it. Arrived at the machine, the pulling drum is thrown out of gear and the outhaul drum thrown in, returning the pulling line to the field. Stumps nearest to the machine are pulled first, so that the more distant stumps will be dragged over the holes left after previous pullings, filling the holes and leveling off the ground, leaving the ground in reasonably good shape.

As the stumps arrive at the machine, they are piled to one side with a piling line and tongs. When necessary, they may be still further cleaned by being dumped on the ground by manipulating this line. When all stumps within reach have been taken from the first strip of the enclosed area, the snatch block, through which the outhaul line runs direct to the pulling line, is moved over a few feet. This operation is repeated until the entire area enclosed by the outhaul is cleared. The machine is then moved into position, commanding the adjoining uncleared area, around which the outhaul is passed. In moving the machine, the anchor is first released and the pulling cable is taken out and fastened to a tree or stump in the desired direction. The pulling drum is then

thrown into gear, when the entire machine moves in the direction of the anchor, riding easily on its broad, curved, steel runners. The entire bottom of the machine being plated, it has a very large bearing surface, enabling it to move with entire safety over wet and soft ground. The curved runners enable it to travel even over very rough country.

The average capacity of the machine described is between 100 and 150 stumps taken one at a time per 10-hour day. As many as 30 stumps have been pulled, skidded and piled in an hour. However, the average, deducting time for moving, unusually difficult pulls, etc., may be about as stated above. In many cases it is possible to take more than one stump at a time, thereby increasing the capacity. The daily water consumption is 2,000 gallons for a 10-hour run, and fuel consumption is approximately $\frac{1}{2}$ to 1 cord of ordinary cord wood per 10-hour day. The capacity of this machine will vary with conditions, of course, as also will the crew required to operate it. An average crew would consist of one engineer, one fireman, one tongman to attack piling tongs, two hookers to fasten chokers, and one foreman. Added to this under certain conditions would be one team and tank for hauling water. Under some conditions greater efficiency can be obtained by adding one leverman to operate the piling line of the stump puller.

Five Chief Causes of Motor Truck Trouble

More Care in Operation and Maintenance Insures Longer Life
for Motor Vehicles

LOAD STRESSES.—The wrenching and straining of body, frame, springs, axles, wheels, etc., caused by the weight of the load, the shifting of the load, or the uneven weight of a badly balanced load. These stresses are present when the truck is at rest, but increase in violence when the truck is in motion.

Road Strains.—These are the terrific strains which attack the engine, transmission springs, frame, body, radiator, etc., caused by the weaving and twisting of the chassis when the truck is traveling on roads where wheels are scarcely ever on a level.

Road Shocks.—These are the sudden ruinous shocks and vibrations against which all driving parts, such as the engine, transmission, propeller shafts, universal joints, differential, etc., as well as all load-carrying and steering parts, must battle as the truck travels over hard, choppy roads or badly

pitted, hard roads filled with bumps, depressions, holes, and other obstructions.

Driving Strains and Shocks.—These are the strains and shocks that are transmitted through the propeller shafts, the transmission, the clutch, the crank shaft, by the power of the engine working against the weight of the truck and the resistance of the road.

Braking Strains and Shocks.—Strains and stresses suffered by rear axle, rear drive, shaft, transmission, wheels, frame, etc., when the brakes are suddenly applied while the truck is under momentum. The effect is similar to that of dropping from a swiftly moving truck a weight heavy enough to stop the truck quickly, the weight being attached to the truck so that it drags on the road.

(Courtesy of Service Motor Truck Company, Wabash, Ind.)

Modern Machinery Moves Historic Rock

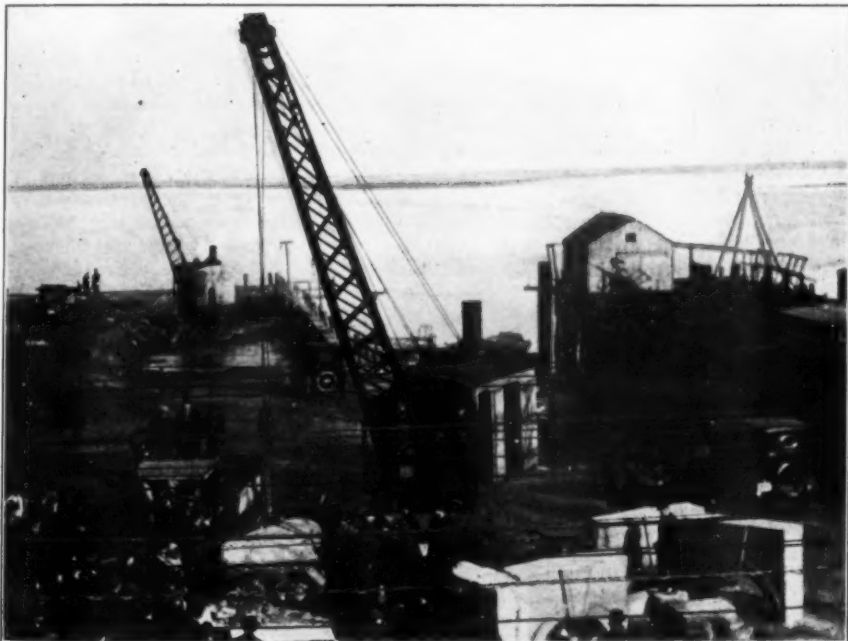
Plymouth Rock, the Stepping-Stone of America, Relocated at Its Original Site

WHEN the Pilgrims landed at Plymouth, Mass., in 1620, it is rumored they first stepped ashore on a rather large boulder. Interest in this rock many years ago caused it to be removed from its original site and placed high and dry where the many tourists who visit Plymouth annually might climb upon it and feel that they were emulating their worthy forefathers.

In the latter part of December, 1920, the people of New England combined their customary observance of Forefathers Day with a Tercentenary Celebration of the landing of the Pilgrims. Aside from an auspicious program of events over a three-day period, the Tercentenary Committee which had the matter in charge appropriated a fund of \$500,000 to restore the water-front to its original condition at the place where

the Pilgrims made their landing from the Mayflower 300 years ago. To do this required the complete restoration of the harbor, involving the removal of more than 15,000 cubic yards of earth. The task was assigned to Powers Brothers, contractors, Brockton, Mass., who operate a fleet of seven 3½-ton Mack trucks, all of which are now working to complete the project. The work is extremely difficult inasmuch as in many places the trucks are forced to travel with full loads through mud nearly 2 feet deep.

When it came time to actually lifting the rock from the location it had held for so many years, to restore it to its original site, an Erie steam shovel equipped with a crane was called to handle gently the precious rock. Later the rock was placed in a warehouse to protect it during the work.



LIFTING PLYMOUTH ROCK FROM ITS RESTING PLACE OF MANY YEARS PREPARATORY TO RETURNING IT TO THE WATER'S EDGE

Policy of State Highway Departments Regarding Open Highway Specifications

THERE has been much controversy regarding specifications in municipal, county and state highway departments as to the inclusion or forbidding of patented pavements. An outline of the practice of the various states has been recently published in "Legislative Index," issued by the New Jersey State Chamber of Commerce, from which the following material has been prepared:

Connecticut.—Open specifications are favored.

Georgia.—Patented types must come in competition with unpatented types.

Idaho.—Patented pavements are in competition with all unpatented material.

Illinois.—Provision is made that bids may be received on types of pavements patented or otherwise, and contracts may be awarded on alternate plans and specifications.

Indiana.—Contracts are awarded only on open specifications, and the state law requires that they, the specifications, must cover three or more types of surface, three of which must be of the hard kind, namely, concrete, bituminous concrete, and brick.

Iowa.—Where bids are being received on patented materials or types of pavements, they are always brought into open competition with unpatented materials of the same general type.

Kansas.—Open specifications are favored. State laws do not permit the so-called patented paving companies to bid on their patents.

Kentucky.—Concerns that bid on patented pavement materials must enter into competition with the unpatented. No contract can otherwise be awarded.

Louisiana.—Patented paving materials are not specified except in open competition with those carrying no patent.

Maine.—No royalties are ever paid on any surfaces laid, and the feeling is that all types of highways ought to be given a free field in public work.

Maryland.—It is the set policy of the State Highway Commission to provide only open specifications.

Michigan.—Bids are accepted only on open specifications not specifying any particular type.

Minnesota.—The standard specifications provide for three types of unpatented top pavements one of which is claimed by one company to be covered by its patent, but there has been no controversy as to the validity of the patent, although 21 miles of that type have been laid by contractors who ordinarily do their work under the patentee's supervision.

Nebraska.—No specifications for any patent or proprietary material, process or type of construction are used unless the materials or methods are purchased or obtained in open actual competitive bidding at the same as, or at a less cost than, unpatented materials and methods equally suitable for the same purpose.

New Hampshire.—Open specifications are always used.

New Jersey.—Open specifications have been the policy for some time.

New Mexico.—Alternate bids are invariably asked on several types of pavement.

North Carolina.—No contracts are let for patented pavements other than in direct competition with patented types.

Pennsylvania.—There is no advertising for patented pavement unless patented pavements are thrown into competition, as there are equally good unpatented pavements.

Vermont.—No contracts are awarded to patented paving companies except through competition with unpatented material.

Virginia.—Firms selling patented materials in this state have to conform to the State Highway Department's specifications in competition with other materials.

West Virginia.—Patented paving companies must meet competition with unpatented materials.

Wisconsin.—Specifications are open, and any type of bitumen meeting the requirements of the work may be used.

Wyoming.—Open specifications are used entirely for all types of road work involving contract work.

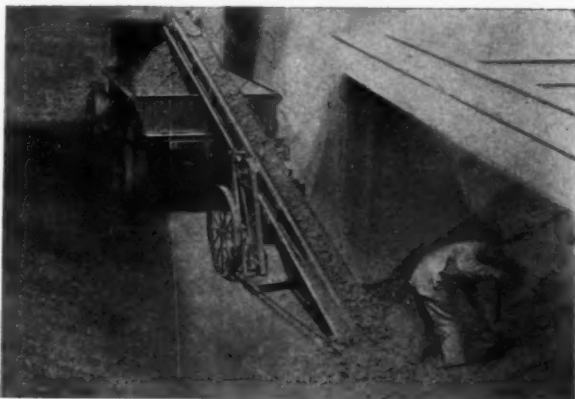
Handling Building Material with Few Men

By E. E. Neuville

EVERY construction contractor is putting forth his best efforts to develop cheaper methods for handling cement, sand, gravel, crushed stone, and the many other materials used for building. It is no longer a case of saving labor, but of a "substitution" for labor. It has always been interesting and profitable to make use of machinery to save labor. Some of the leading contractors in this country are handling materials with a scoop conveyor made by the Portable Machinery Company, Passaic, N. J., and claim that it is a great labor-saver.

The most distinctive feature of this machine is the scoop on the feeding end, which can be pushed into or completely buried in the material to be conveyed. This makes it possible to simply scrape the material on the carrying belt, instead of lifting it up by shovelfuls into the feeding hoppers of ordinary conveyors.

The money savings from the use of a scoop conveyor are due, first, to the saving in labor; second, to the speed at which material is conveyed. In comparison with han-



ONLY ONE MAN NEEDED TO LOAD THIS TRUCK

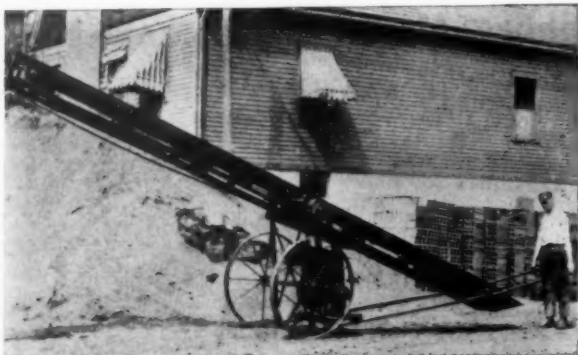
dling material by hand, one or two men with a conveyor will do the same work as from four to twelve men without, depending upon conditions. The conveyor will load trucks in one-fourth to one-sixth the time required by men shoveling. It often enables one truck to do the work of two trucks and to get two days' work done in a single day.

In unloading hopper-bottom cars, the conveyor can be used without providing a pit under the track. This saves the construction of a track hopper and makes it possible to unload cars at any point along the track. To unload cars it is necessary only to place the feed end of the conveyor near the car hopper and then drop the door. The belt carries the material away as fast as it flows through the hopper opening.

In addition to saving labor in unloading cars, the conveyor saves car demurrage, as it permits of unloading cars in a few hours. One man and a conveyor under ideal conditions can unload a 50-



LOADING TRUCK IN RECORD TIME



REALLY A PORTABLE CONVEYOR

ton car in one hour. Under average conditions, it requires about $2\frac{1}{2}$ hours, depending on the style of hopper-bottom car and the natural flow of the material to the discharge doors. Storage capacity is another factor of saving attributed to this machine, as it increases the available capacity of a shed or yard space by enabling men to pile higher.

The carrying capacity of the conveyor, based on handling coal, sand or similar material, is 1 ton per minute, provided a sufficient amount of coal is maintained at the receiving end of the machine. If the storage pile is of sufficient height, 1 man can easily feed 1 ton in $1\frac{1}{2}$ minutes, or if the pile is low, he may require from 2 to 4 minutes. Where speed is required, 2 men may be provided for feeding.

Large size coal, coke, crushed stone, etc., fed by 1 man require from 3 to 6 minutes for 1 ton, or half that time with 2 men.

Construction

As may be seen from the first illustration, the conveyor is strongly constructed, light in weight, compact and portable. The steel frame holding the rollers and conveying belt is mounted on the wheels so that the balance is perfect. One man, by inserting the pipe handles

into the ends of the horizontal members, can easily lift and move the machine around. The total weight of the 12-inch by 20-foot size machine with motor is about 1,100 pounds.

The machines are equipped with either electric or gasoline engine as desired. The motor or engine is mounted under the frame on the wheel truck, and transmits power to the conveyor by means of a chain and sprocket

connection to a shaft extending beneath the conveyor. From the sprocket on the outer end of this shaft, the power in turn is transmitted to the driving sprocket located at the upper end of the conveyor.

The head, tail, and countershaft bearings are adjustable, self-aligning bronze graphite bearings. Roller chain and cut teeth sprockets are used. The belt-supporting rollers are made of hardwood fitted with chemically treated oilless bearings, and are spaced 7 inches apart, center to center. The conveying belt is of high grade heavy duck and rubber construction, fitted with either high-arched rubber and duck carrying flight, as shown in the first illustration, or with low cross-strips, depending on the kind of material to be conveyed. These transverse cleats are provided to prevent the material from slipping back down the incline.



CONVEYOR FOR EXCAVATING, OR HAULING SAND AND GRAVEL

The conveyor is made in three different lengths, 16 feet, 20 feet and 24 feet. The width of the conveying belt on any of these sizes may be either 12 inches or 16 inches wide as desired. Size 14 feet is elevated to a total height from the ground of from 4 to 6 feet; the 20-foot size may be adjusted for any height from 6 to 9 feet; and the 24-foot size may be adjusted for any height from 9 to 12 feet.

ACKNOWLEDGMENT.—Illustrations from *Contractor's Atlas*.



A THREE-TIER CONVEYOR PERMITS SAVING SPACE BY HEAPING HIGH

Storage Systems For Sand, Gravel and Crushed Stone

HANDLING-SYSTEMS for mixed concrete have been well worked out, but the mechanical handling of sand, gravel, crushed stone and cement or other material about concrete mixing plants, particularly for building construction before it reaches the mixer, has been a sadly neglected detail. There are two problems which usually stand out prominently at all handling plants: the supply of material—where it comes from, and how, and in what volume; second, how to take this material from cars, wagons, boats or other conveyances economically and place it in storage from which it may be drawn without hand labor in such quantities as to allow the mixer to run at full capacity.

While the source of supply must be considered, the most important point in an economical concrete mixing plant is an ample storage of the various materials ready to run into the hoppers of the mixer by the simple operation of a lever. The work bins should be so designed that they can be erected at the most convenient point at a reasonable cost and when the job is completed may be easily moved to another location. Storage systems must naturally vary in size and arrangement according to conditions. They may be composed of bins holding a few yards or wagon loads of material directly over the mixer, or of bins holding hundreds of yards of material and connected by suitable reclaiming conveyors to the work bins.

The general principle involved in the construction of the unit type bins made by the Weller Manufacturing Company, Chicago, Ill., is the assembling of various standard unit sections in such a manner as to develop one or more complete bins of uniform or different sizes. These bins may be arranged in various formations to suit the requirements, and are regularly made in sizes ranging from 15 to

150 cubic yards in capacity, all of interchangeable sections, and may be set up in a row in the shape of an L or a T, a quadrangle, or in any other arrangement which conditions may require.

The sides are made up of panels or sections which when bolted together and to posts and cross-struts form a solid and substantial structure which has many points of superiority over the regular built-up bin. At the same time, by removing a comparatively small number of bolts, the entire structure can be taken apart quickly, loaded on a freight car or truck, and transported to another location. When all the units are in place and the bolts tightened up, the entire bin forms one solid structure, doing away entirely with the need of braces and tie rods, with the exception of the stay rods across each bin.

The R. D. Baker Company used a Weller plant for the first time in the spring of 1915 in connection with the construction work on some of the Wayne County roads radiating from Detroit, Mich. Pit-run sand and gravel were received in drop-bottom cars, the material being dropped through the tracks onto a hopper, from which a Weller feeder delivered to a standard stone and ore elevator. This elevator carried the material up and discharged it into a washer, which thoroughly cleaned the material and separated the sand and gravel, dropping them into two separate bins.

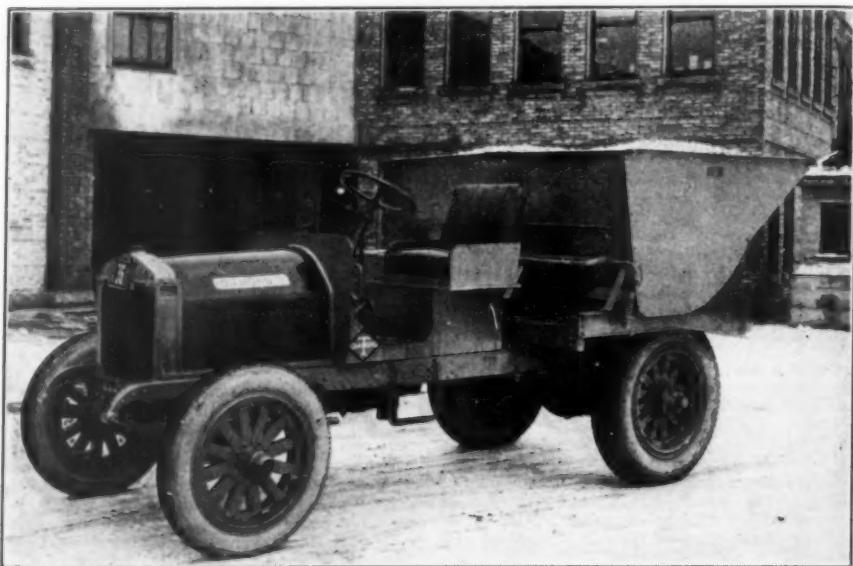
The narrow-gage railroad with dump cars which operated under these bins carried the washed and sized material from the bins to the concrete mixing plant, which was located at any distance up to $3\frac{1}{2}$ miles according to where the work was being carried on. The plant has been taken down, reerected and used several times on other jobs since the first installation, thus making a considerable saving through reuse of the storage plant.

Special Dump Models for Contractors' Trucks

BECAUSE of the increasing demand for small road-building motor trucks, the Diamond T Motor Car Company, Chicago, Ill., has brought out a new "Contractors' Special" model road-building truck, particularly adapted to this service. This new type of truck was offered last fall to one of the largest contracting firms in the country, the R. F. Conway Company, Chicago, Ill., which gave it a rigid test for some time on a strip of road near Morris, Ill. As a result of the work done by this truck, the Conway Company has purchased 10 "Contractors' Specials" for spring delivery and will use them on its contracts during the coming year.

larger tires were used, because practically all the load is carried on the rear axle. The truck is so designed that the load is properly balanced even when operating on a steep incline.

Simplicity in design has been combined with sturdy, rigid, compact construction; non-essential accessories are eliminated; lamps have been removed; a step bracket takes the place of the step board; it has a single seat only, and the space taken for the second occupant is used for a large, roomy receptacle for tools. Standard equipment includes radiator guard, and one tow-hook front and rear. The frame cross-members have been placed to give the hoppers the best possible support, and the heavy-



SHORT WHEEL BASE TRUCK WITH TWO DUMP HOPPERS

It is claimed that this type of truck will save 25 to 50 per cent over the older conventional methods of distributing sand, gravel, crushed rock, and cement where equipment used varies from 1- to 5-ton units. This truck is equipped with dual end-dump Lee Line hoppers constructed of No. 10-gage steel throughout, each having a capacity of 1 cubic yard, giving a total load capacity of 5,000 to 6,000 pounds. The short wheel-base enables it to turn easily on an 18-foot subgrade. It is fitted with pneumatic cord tires, 35 by 5 inches front, 40 by 8 inches rear, allowing operation on soft ground and protecting the subgrade from being broken down. Using smaller size tires in front decreases the turning radius, and the weight is supported just as safely as though

duty truck motor of 4-inch bore by 5¼-inch stroke, develops 43 horse-power. The carburetor is equipped with an air strainer to prevent dust from entering the combustion chamber and scoring the cylinders and bearings.

Auxiliary springs carried on each frame member and resting on the spring box prevent spring rebound and relieve side-sway. This is claimed to be a valuable feature when the truck is being used for maintenance and repair and only one hopper is filled, which naturally tends to throw the load on one side of the chassis. The hoppers dump by gravity upon release of the trip bar, allowing instant and complete scavenging of either set or dry mix. The dumping shock is absorbed by a coil spring.

Motor Trucks Invaluable to Quarrymen

An Outline of the Use of Motor Trucks by Gottron Brothers, Fremont, Ohio, in Quarrying and Distributing Stone

IN the production and distribution of stone, Gottron Brothers, of Fremont, Ohio, have demonstrated to their own satisfaction the great value of the motor truck for contractors. Gottron Brothers operate their own quarries, where stone is blasted out and then loaded onto motor trucks, both by steam shovel, as illustrated, and by portable electric conveyor. Before the motor trucks were put in operation, horses were used. The most that 6 horses and 18 men could haul from the quarry to the crusher, a distance of about 200 yards, was from 15 to 18 tons of rock an hour. One Service motor truck and 6 men are now delivering 40 tons an hour to the crusher.

After the trucks are loaded and the material crushed, it is divided into several sizes, ranging from fine dust to about 4-inch stone,

used in road work. The different sizes, dust, $\frac{1}{4}$ -inch, $\frac{1}{2}$ -inch, 1-inch, 2-inch and 4-inch, are then screened into separate bins, under which the trucks are run to get their loads. The material is dumped directly from the bins into the bodies.

From these bins the trucks haul the various sizes of stone to the road or building contractor. From the bottom of the quarry to the point at which the trucks emerge at the top is a distance of slightly over 200 feet, and in that distance there is a rise of 35 feet. It is necessary that each truck negotiate this steep grade of 17 per cent on an average of about 20 times a day. From the quarry the crushed stone is hauled any distance from 1 to 13 miles.

The four $3\frac{1}{2}$ -ton Service trucks owned by Gottron Brothers average from 85 to 100



LOADING SHATTERED STONE FROM QUARRY FACE INTO TRUCK FOR HAULING TO CRUSHER

miles a day for a day of 10 hours, and have made as high an average as 106 miles a day for a two-weeks' period. This record was made when trips were long and only four round trips a day were necessary in delivering to a job a little over 13 miles from the quarry. When more than 8 trips are made, the average mileage runs somewhere around 85 miles, for the greater part of the working day is spent at the loading bin instead of in traveling.

In addition to the crushed stone work, Gotttron Brothers have a three- or four-year contract for hauling stone to Sandusky Bay for riff-raffing or filling in swamp land to preserve it for duck shooting. Thousands of acres are being worked on at this time. For this work stones weighing from 20 to 120 pounds are used. These are loaded at the quarries and taken directly to the river, where they are automatically loaded on huge barges and towed 18 miles to the

dumping-ground.

Special care is taken by this firm of quarrymen and contractors to engage only the best motor truck drivers, men who do not hesitate to shift gears when going over a bump instead of speeding up and going over by merely slipping the clutch, and the firm pays its drivers substantial salaries.

The oldest truck in use has been at work for four years, hauling the regular load of 10,300 pounds. The entire expense for the four years for this truck has been less than \$700. This includes two repaintings and a general overhaul last winter, when work was slack. The truck suffered an accident during a day-and-night job some time ago, when with its regular load it went over a 30-foot embankment on a highway a little after midnight. The truck turned over twice in rolling down the bank. In three hours' time it was put on its wheels and started off without difficulty.

Bituminous Concrete Foundations

IT is interesting to note the summary of advantages of bituminous concrete foundations as given by Hugh W. Skidmore of the Chicago Paving Laboratory, in a paper read before the Illinois Society of Engineers.

Mr. Skidmore summarizes the advantages of bituminous concrete foundation briefly as follows:

(1) Provides homogeneity of mass and positive bond between foundation and wearing surface when bituminous top courses are employed.

(2) Provides uniform contact with the subgrade, thus insuring the benefit structurally of all of the beam strength possessed by the foundation slab, and at the same time makes certain the uniform distribution of load to the subgrade.

(3) Because of the inherent flexibility of the material, the foundation slab will at no time be called upon to act as an arch over weak subgrade areas, therefore the possibility of the foundation's rupturing, as is frequently the case with Portland cement-concrete, will be reduced to a minimum.

(4) Provides freedom from cracks and upheavals.

(5) Insures against the presence of moisture in the foundation structure, thus pro-

longing the life of the pavement.

(6) May be easily repaired at minimum cost, the surface patch method being applicable except in the case of very serious defects.

(7) Provides decided economies in construction, as it dispenses with the equipment and organization necessary to lay cement-concrete, thus affording the contractor the advantage of exclusive use of that portion of his ordinary equipment and labor organization which in actual operation has heretofore proved to be the most economical and thereby profitable.

(8) Does away with the long period of time required for the curing of the foundation, thus permitting the opening of completed work to traffic immediately and providing a rapidity of turnover to the contractor not possible in the case of rigid foundations.

(9) Permits the use of the same materials, except cement, as are employed in cement concrete work.

(10) Under similar conditions, using the same aggregate materials, bituminous concrete of equal thickness will be found to be cheaper than cement-concrete at present prices.

Penetration Macadam Roads

A Discussion Prepared Especially for Contractors on the Various Phases of Construction

By Philip P. Sharples

Manager, General Tarvia Department, The Barrett Company

CONTRACTORS in many parts of the United States seem to prefer to bid on expensive types of pavements rather than on the cheaper types, under the mistaken idea that there is more profit the higher the cost per mile of a road.

A little consideration will show that the big mileage in any community is in the cheaper types of road. Roads are not different from houses in this respect. In any community there are a few high-priced houses. A contractor deems himself fortunate if he gets the contract to build one of these. On the other hand, the money in building is in the construction of the vast number of medium-priced structures required.

A Good Business Proposition

Among road structures, the penetration macadam stands as a type of medium-priced

construction that gives eminent satisfaction if the somewhat simple principles involved are thoroughly understood and faithfully carried out. This is well known in some communities, and contractors enjoy a good business in this class of work. In other places, the contractors try to throw all the contracts to higher-priced work, either by not bidding at all or by bidding unreasonably high on this type of pavement. In either case, the contractor loses eventually, as in the end the road authorities generally turn to force account work for this class of construction. If the contractor were wide awake, he would foster this class of construction and keep the field for himself.

Penetration work is an attractive field for the contractor, as a minimum amount of apparatus is necessary and highly skilled labor is not required except in the handling



STONE SPREADER LAYING WEARING COURSE FOR PENETRATION MACADAM ROAD

of the bituminous materials through the modern spraying apparatus. In many parts of the country this service is available from the plants of the producers of bituminous materials, so that the contractor can shift the burden of spreading to others.

Successful penetration work presupposes good, clean stone. Many failures can be attributed to neglect of the quality of stone or to spreading fairly good stone in such a way as to accentuate its uneven qualities. There is a new field scarcely touched in the development of successful apparatus for spreading stone on the job. A contractor that is wide awake will give a lot of thought to this part of the program.

To Secure Success

The specifications should be scanned carefully by the contractor to see that sufficient depth of foundation is given to insure a lasting pavement, and to see that provision is made for properly filling the base before the top course is spread. These requirements are common to every type of pavement, but owing to the simplicity of the penetration work, the principles are often neglected. A macadam base for a penetration top should be just as carefully prepared as if the surface were to be left as a water-bound macadam.

The penetration top should be built of good, clean stone, as bituminous materials do not adhere to dirty stone. Dirty stone produces unsatisfactory pavements which are no credit to the contractor. Good business would counsel that the contractor should be interested to get proper materials in order that his business may develop satisfactorily and in order that he may command a better price for his work than work done by slovenly contractors.

Much of the success of the penetration top depends also on the proper rolling of the surface. The local stone should be carefully studied by the contractor in conjunction with the engineer, and the best possible way of handling it to get good results should be worked out. Each stone has its peculiarities which must be humored in rolling and in the spreading of the bituminous material. As a rule, the softer the stone, the less rolling permissible before the application of the bitumen. Soft stone crushes under the roller, and if the rolling is too long continued, the surface will close up so that the bituminous material cannot gain entrance

into the road. In consequence, it lies as a blanket on top, and eventually breaks up, leaving stone beneath it with no binder. On the other hand, good trap rock that keys together well can be so thoroughly rolled before the refined tar is applied that the spraying apparatus makes no impression on the surface. A stone like this is ideal, but is present in very few parts of the country.

The economy of penetration pavements lies in utilizing the local materials so that the bulk of the work is with the softer rocks. Slags in the iron manufacturing regions make good substitutes for rock, usually at a saving in cost.

Handling the Bituminous Material

The application of the bituminous material should be as carefully studied as the putting down of the stone. Usually the companies furnishing refined tar and other binders can be depended upon to give the best advice in regard to the delivery and application of bituminous material. They have made a special study of this problem and know the best methods of handling their own materials. If truck equipment is available, it forms the best method of application. Usually a contractor can afford to pay quite a few cents more per square yard for the use of this apparatus than he could for any method using kettles and pouring-pots. A saving is made in heating and in labor that is little appreciated by those who have not been through the mill. Not only is a saving effected, but the work produced by the power spraying apparatus is much more satisfactory in the end, and there is no question about the proper distribution of the material.

Careful attention to the chinking in of the surface and to its thorough rolling before a seal coat is applied, is an important step in the construction of a penetration macadam. Relatively, it is much more important that the seal coat be put on by power sprayers than that the penetration of the wearing course be done by this method. The covering of the seal coat with clean pea-stone or pea gravel and its proper rolling are very simple operations. Where penetration macadam has been much used, it is found to be good pavement insurance to finish up with a double seal. The last seal coat is put on by truck. Instead of hot binder, a cold application tar is found most desirable. This tends to seek out and heal



APPLYING BITUMINOUS BINDER TO WEARING COURSE

up any slight defects in the pavement and gives a seal that excludes water thoroughly, so that the pavement usually needs little attention for a long time, provided the traffic is suitable for this class of construction. Contractors are not so often called upon to guarantee penetration macadam construction, or, if called upon for a guarantee, are required to look after it only for the first twelve months. It is important, therefore, in case a guarantee is called for, for the contractor to see that he is protected by the double seal specification.

The thousands of miles of work done by the penetration method all over the United States show that for many types of traffic the pavement is the cheapest per ton-mile of traffic sustained of any of the more durable types of pavements. It is surprising to see how well this type of work stands up under modern truck traffic, provided the foundation and drainage have been honestly cared for. The future should see a constantly increasing mileage of penetration macadam roads because of their stamina and inexpensive construction.

What Is a "Responsible Bidder"?

An Unfortunate Phrase Which Needs Clarifying

"The lowest responsible bidder" on state and municipal work is by law usually designated as the bidder to whom a contract shall be awarded. This phrase has been extremely unfortunate to both state and contractor, as officials have gradually, for want of a more explicit definition, been obliged to extend the meaning of "respon-

sible" to include anyone who can furnish bond. This construction of the term, which has led to many disasters in the building of public works, is in sore need of revision. Through the efforts of a joint committee of engineers and contractors, a determined effort in that direction is under way in St. Louis.—*A. G. C. Bulletin* March 26, 1921.

Earth Work on Road Jobs

Earth Work Important in Bidding, As it Forms Usually More Than One-Third of the Work to Be Done

IN most of our road construction at the present time the earth work forms from 20 to 40 per cent of the total cost of the completed road. In some of the lower types the earth work and drainage structures comprise practically the total cost. It is, therefore, very important that careful attention should be directed toward devising economical methods of performing this work.

In no other line of road work are there available so many different methods and such a wealth of examples of inefficient management. Somehow there seems to be prevalent a conception that in earth work efficiency simply means "making the dirt fly," while in reality all that is usually accomplished by such procedure is "making the profit fly." For example, a contractor was employing on one job 4 wheel scraper gangs of 6 teams each. No attempt, however, had been made to grade the gangs in accordance with the natural speed of the several teams, nor to keep a check on the number of trips made by each gang. The result was that each gang was held to the speed of the slowest team and driver in each, which was about 25 per cent slower than that of the fastest. A simple rearrangement of the teams, according to their speed, the discharge of one purposely slow driver, and the installation of a simple process of tallying the trips made by each gang, increased the daily output of the entire outfit 20 per cent.

There is also a too common idea that any method and any old outfit is good enough to do earth work with. Nothing could be wider of the truth. Poor, inadequate and unsuitable equipment, as well as anything short of the method best adapted to the special conditions, is sure to seriously enhance the cost. The particular method to be chosen in each case will, of course, depend on the local circumstances and conditions.

Rate of Various Methods

In order to determine the most economical methods of performing a given piece of work, it is necessary to know the rate at which the work can reasonably be expected

to be done under the different methods under consideration. Under average conditions a man may be expected to shovel into an ordinary farm wagon 20 cubic yards of light sandy soil, or 15 cubic yards of heavy soil, well loosened, per day. As the number of shovelers to each wagon is increased, the average daily efficiency will decrease, and when 10 shovelers are employed at one wagon the average efficiency will not exceed 85 per cent.

One plow or rooters gang provided with sufficient horse-power and plow holders to keep moving fairly steadily can loosen about 300 to 400 cubic yards per day. Sometimes two rooter plows are drawn by one tractor. Still better results can usually be secured in very hard and tough ground by a scarifier drawn by a tractor or roller. In ground of this nature blasting is usually more economical where the depth to be loosened exceeds 3 to 4 feet.

Drag scrapers have a gross capacity of 3, 5 and 7 cubic feet, and a net effective capacity of about 60 per cent of these quantities. On a 25- to 50-foot haul about 7 scraper teams can usually be employed, and each will place under average conditions 50 to 65 cubic yards of compacted fill per day.

Fresno scrapers have a capacity of 7, 12, 14 and 18 cubic feet, the larger sizes requiring 4 horses. On the same length of haul, providing the conditions are favorable, the larger Fresno scrapers can be expected to handle from 75 to 100 per cent more material than the slip scrapers. Wheeled scrapers are of three sizes, having a working capacity of $1/5$ -, $1/4$ - and $1/3$ -cubic yard each. For a haul of 100 feet, 6 scraper teams can usually be employed to good advantage, and each will place about 55 to 65 cubic yards of compacted fill per day.

The road grader or road machine with an 8-foot blade can be expected to move from 300 to 500 cubic yards per day in grading a 25-foot roadway. Larger graders, if supplied with sufficient power, will move a proportionately larger amount of earth.

On favorable stretches, a half-mile or more without a turn, a tractor-drawn elevat-

ing grader may be expected to load 650 to 750 cubic yards per day into $1\frac{1}{2}$ -cubic-yard dump-wagons. If the material is simply deposited on roadway, the daily output should be from 900 to 1,100 cubic yards. Where much earth work is encountered, a steam shovel is frequently employed. Those used for road work usually have a dipper capacity of $\frac{1}{2}$ - to $\frac{3}{4}$ -cubic yard and a daily output of from 200 to 250 cubic yards as a minimum, to 500 to 650 cubic yards as an average maximum.

Blasting Earth

In cuts of any considerable depth and where the material is loosened with difficulty, it is often blasted. When the cut is less than 6 feet deep, a row of holes is sunk on a line back from the face a distance about one-fourth greater than the depth of the cut and about the same distance apart. When the cut is 6 or more feet deep, the line of holes is kept about 6 feet from the face and the holes are sunk about 6 feet apart. They are loaded with a low-strength dynamite, and care must be taken that the holes are not so deep as to loosen the ground below the finished grade line. The use of explosives in road grading in other material than rock has been extending rapidly on account of its low cost and the rapid progress that can be made under suitable conditions, for the blasts leave the clay or hardpan in a broken-up condition, making it easy to handle. On side-hill cuts in heavy ground, where the slope is steep and there is some question about the security of an embankment to carry the outer part of the road, a safe roadway can often be blasted out of the hill at a cost comparing favorably with a road partly supported by a fill or a retaining wall. Even on easier slopes where a long side-hill cut in heavy ground must be made and the excavated material can be employed as an embankment to carry the outer part of the roadway, the excavation is often made by blasting. Blasting is also an effective method of breaking up stumps and boulders. By blasting the frozen earth steam shovel work can often be carried on in winter.

Where rock is encountered in any considerable quantity, a portable compressor and either hammer or larger air drills should be provided. For small amounts of rock work and the removal of heavy boulders a hammer drill operated by steam from

the road roller, steam shovel or any other convenient source, can often be utilized to good advantage.

Earth-Moving Equipment

Where the material is easily handled and can be dumped within 100 feet of the cut, slip and Fresno scrapers are generally regarded as the least expensive equipment. If the haul exceeds 100 feet and is under 800 feet, wheel scrapers rank high. The large sizes are most desirable for economy on hauls over 400 feet. The material is usually plowed so the wheelers can be loaded easily, and it is necessary to have about one of them for every 100 feet of haul in order to work most economically. In a few cases the still larger Maney scrapers have been employed very successfully. In at least one case a cable from a hoisting engine was used very economically and effectively to load these scrapers. Bottom-dump wagons can be made to give very low hauling costs if enough are provided so that while one is being loaded at the cut, the driver and team which brought it in can be used in hauling a loaded wagon. Where a tractor or large truck is available as power, a scarifier may be used very economically to break up especially hard soils. In very wet cuts and where it was necessary to expedite the work during the rainy season, the drag line excavator has been employed very successfully.

In recent years traction steam shovels have often been used for road grading. They make shallow cuts as easily as deep ones, and have taken out earth and rock at very low figures when the equipment for removing the excavated material was sufficient to keep the shovel working most of the time. In most steam shovel work a good powder man is almost a necessity, as in all hard and stony soils the output can be greatly increased by the use of powder to loosen the soil, break up boulders, etc. The economy of steam shovel operation depends upon the proportion of the working day that it is actually digging, and this depends upon having wagons or cars ready to receive the excavated material. The wagons or cars may often be run along the top of the bank of a shallow cut and kept moving in a continuous line, saving the delay of turning and backing up to the shovel, which is necessary when they move over the grader cut. The utility of a shovel on road work

is increased if it can be employed in a gravel pit or quarry when not grading.

Grader Work

A large part of the earth roads now built or reconstructed, especially in the prairie states, are made with road machines. These are built in many sizes for both horse and tractor hauling, and serve a variety of purposes in an economical manner. They are not adapted for making cuts and fills, although frequently employed in shaping a road after the grading has been done.

If the work is on a scale large enough to warrant the use of two graders hauled by a tractor, a trained grading crew is often able to build a good road-bed at very low cost. Mechanical traction has resulted in the development of methods of construction impracticable when teams of 4 or 8 horses were employed, and as a general proposition mechanical traction is most economical when the sections to be graded are a half-mile or more long, and there is enough grading or other work in the vicinity to keep a tractor busy most of the time. Time lost in standing idle or moving long distances from one grading job to another reduces the economical advantage of a tractor on work not well organized.

In organizing grader work, it is desirable to keep on hand repair parts of the machines as well as plow-points and other parts of

the equipment likely to wear out. The small tools should be selected with the same care as the other equipment. Experience has shown that even the shape of a shovel, for example, has considerable effect on the amount of shoveling a man can accomplish in a day. Hard earth cannot be dug economically by the shovel best adapted for loose earth, and neither is best for gravel and broken stone.

On extensive work the elevating grader has proved an economical and rapid machine when a mile or more of road can be traversed without turning the outfit. Such a grader is best drawn by a tractor which on embankment work serves to roll the grades as it is built up, and thus assists materially in making a compact road. The method of using the grader depends upon the nature of the work to be done. In long cuts the grader discharges the excavated material into wagons, which haul the material to the fills. On embankment work the cut is usually started at the shoulder, and the grader moves toward the roadside on successive rounds, so that the excavated material is deposited nearer and nearer to the center of the road by the elevating and discharging device. The road should be dragged during construction, and as soon as the rough grading is finished it should be shaped at once with a road machine hauled by truck or tractor.

Ready to Sprint to the Mixer



WHITE TRUCK USED BY UNION PAVING COMPANY, PHILADELPHIA, IN SAND AND GRAVEL HAULING FOR STREET AND HIGHWAY WORK



Why Maintain Antiquated Roads

The cost of maintaining water bound macadam roads is high if they are subject to the damaging effect of heavy automobile traffic.

An asphalt macadam surface applied to such a road greatly reduces upkeep.

Construction cost on this type of pavement is greatly reduced due to the fact that the old water bound road makes an excellent base.

The road shown above is an example of such reconstruction. It was built in 1917 with

STANOLIND PAVING ASPHALT, "C" (Penetration Method)

Its present excellent condition
has not cost one cent for repairs.

Our booklet "Stanolind Paving Asphalt" containing information regarding this type of road as well as all other asphaltic roads will be mailed free upon request.

STANDARD OIL COMPANY
(INDIANA)

910 So. Michigan Ave.

Chicago, Ill.

Motor Truck Fleet Serves Stone Crusher

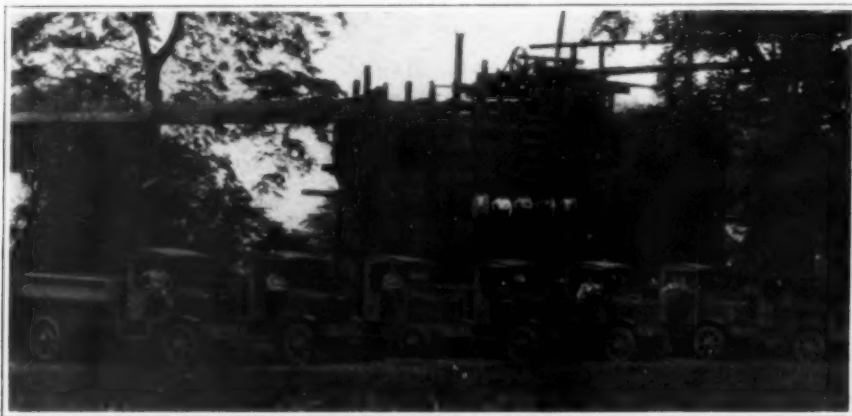
Seven Trucks Operated by Acme Gravel Company, Indianapolis, Ind., Supply Sand and Gravel to Contractors and Builders Throughout the City

IN August, 1919, the Acme Gravel Company, Indianapolis, Ind., purchased one 5-ton Service truck. From time to time other trucks have been added, until the fleet now consists of seven 5-ton trucks. In their regular line of business the trucks operate from the plant at Kentucky Avenue and Eagle Creek in Indianapolis, having contracts with the Cole Motor Car Company, Stutz and Marmon. In addition to these, they supply sand and gravel to contractors and builders throughout the city.

On an average the trucks make 10 trips a day of about 7 miles each. Sometimes the

Alley, sends it out to haul lumber and cement and to work on excavating jobs. On excavating work Mr. Alley has found these trucks exceedingly reliable, as it is necessary to make a quick get-away on leaving the steam shovel after being loaded, where excavation is under way.

Particular attention is paid to keeping the motors in the pink of condition. The trucks are thoroughly greased and lubricated every week, the oil in the motor is drained, the crank case is flushed and refilled with new oil every 1,000 miles. Only high-test gasoline is used, and the National



THE FLEET OF TRUCKS THAT OPERATES FOR THE ACME GRAVEL COMPANY, INDIANAPOLIS

trucks work seven days a week, inasmuch as buildings for some concerns are being rushed to completion. During the early part of the spring of 1920, when extreme freight congestion caused so much trouble, the trucks were running daily to Greencastle, loading with bags of cement and returning to Indianapolis. During this period the daily mileage was 105 and the return load was 108 bags of cement, average 95 pounds to the bag. The mileage per gallon of gasoline during this run varied between $4\frac{3}{4}$ and 5.

At present the trucks are engaged primarily in hauling sand and gravel, but whenever any truck is idle, the owner, J. L.

Standard Truck Cost System shows a mileage of 4.1 miles to the gallon, a considerable increase over the record of an experimental period with a lower grade of gas. Not only is the mileage increased, but it has been found that the truck has more power and there is less trouble from carbon deposit.

Truck No. 1 has worn out its first set of tires after running 7,700 miles over very poor roads. These tires were Kelly duals, and on being replaced with Giant treads it is expected that it may be possible to run the mileage up to 10,000.

The accompanying cost data on the opera-

ANOTHER
Progressive
CITY
installs
"THE
EFFICIENT
PIPE"

*Section of line
coming
from
reservoir
at top of
hill*

625 TONS
UNIVERSAL PIPE
installed by
APACIFIC PIPE
and
THE CENTRAL
PIPE COMPANY
BOWEN STREET
NEW YORK
NEW YORK, CHICAGO
PHILADELPHIA, SAN FRANCISCO

CITIES
and all
users of
UNIVERSAL
CAST
IRON PIPE
find it unequalled for
low cost installation
and enduring service

D-338

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tion of the Acme Gravel Company trucks includes interest figured at 7 per cent, depreciation of 20 per cent, insurance, driver's salary at \$5 a day, taxes, state and city license, and an allowance of \$200 for administrative overhead. Gasoline has been figured at 31 cents per gallon.

If you have not already carefully examined the National Standard Truck Cost System, you can secure a copy free from the Contractors' and Engineers' Monthly.

SERVICE MOTOR TRUCK COMPANY, WABASH, INDIANA, U. S. A.

COST DATA

ESTIMATED COST OF OPERATING SERVICE		5	TON TRUCK, MODEL
In the Service of	Acme Gravel Co.		Hauling Sand and Gravel
Address	Average of 7 trucks.		
INVESTMENT			
Chassis			\$500.00
Body			\$584.00
Cab			\$560.00
Painting—Chassis and Body			\$560.00
Lettering			\$560.00
Freight			\$590.00
War Tax			\$590.00
Special Equipment			37654.00
Total Investment		\$407 71	
Subtract Tire Value			394 20
Total for Computing Sinking Fund			5013 51

FIXED OPERATING CHARGES*	PER ANNUM		PER DAY
7% Interest on Average Investment	227 12		
Depreciation (Sinking Fund) ... % per annum	1002 70		
Insurance: Aver. \$139.00 and \$162.00	150 00		
Fire and Theft, Property and Liability			
Garage (Rent, Light, Heat, Power) ... None			
Driver's Salary \$50 per hour 10-hour day	1580 00		
Helper's Salary (Seldom included)			
Taxes ... Approximate Average	36 00		
License State \$40.00 City \$21.00	61 00		
Administration Overhead ... Approximate	200 00		
Total Fixed Charges	3235 82		10 79

FIXED CHARGES PER MILE	PER MILE	
Gasoline: 4.4 miles per gal. at .31¢ per gal.		0756
Oil—Engine: 145 miles per gal. at .79¢		0053
Other Lubricants: 50¢ per gal. grease, kerosene, 800-#		0010
Tires—Based on 10,000 Mile Guarantee		0394
Maintenance and Overhauling. Actual \$.0100. Approximate		0400
Total		1613

TOTAL COST PER DAY FOR VARIOUS MILEAGES

Daily Mileage	30 Mi.	40 Mi.	50 Mi.	60 Mi.	70 Mi.	80 Mi.	90 Mi.	100 Mi.
Daily Charges					10.79			
Mileage Charges					11.29			
Total Cost					22.08			

* Daily Charges based on 300 working days per year.

Date _____ Signed _____

3M 10-20 TS

Negligence Cost||\$8,000

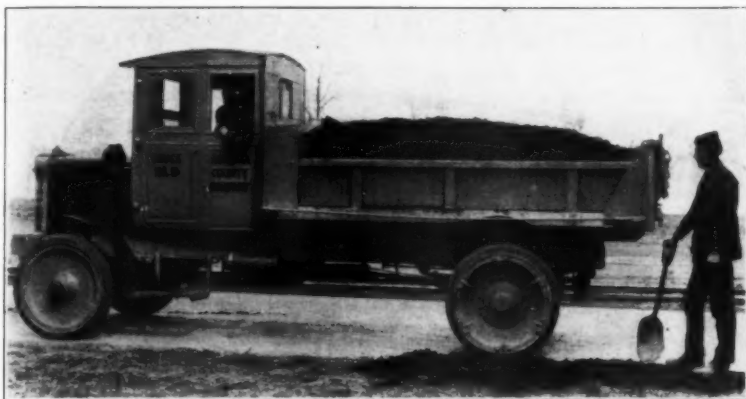
A LLEGED negligence on the part of contractors of an Omaha building netted Mrs. Jennie McCain and her children \$8,715.60 more than they otherwise would have received as result of the death of her husband, Thomas McCain.

Facts of the case made known through the office of Frank Kennedy, Secretary of the Nebraska Department of Labor, show:

Last June McCain, who was employed on the new building as a structural iron worker, fell from a steel beam high in the air and was killed. Ordinarily, under the Workmen's Compensation Act his widow

would have received \$4,474.87, but, it was revealed that the builders had neglected to plank the floors of each story as the building progressed, in violation of the Nebraska labor law. Suit was filed against the builder, and the case was settled outside of court. Mrs. McCain was awarded an additional \$8,715.60, making the total award \$13,191.47. Contractors would do well to comply strictly with state laws, especially those requiring builders of steel buildings to plank every tier of beams as the building is constructed.

A. G. C. Bulletin, March 26, 1921.



Winther Trucks Maintain County Roads

There is a size and type of Winther for every trucking need. Write us to-day for literature and prices.



The excellence of Kenosha County highways is due, in large measure, to Winther hauling service.

Summer and winter, you can see this 3½-ton Winther pulling heavy loads of gravel from the pit, distributing cement, sand, and ashes, or transporting "fill-in" material to outlying points of the county.

Dependability is the keynote of its service.

"But in spite of this strenuous hauling" says Commissioner Herzog, "our Winther has cost us practically nothing. \$14.44 represents its total repair bills for the past year. Fuel and lubricating expenses have been in the same moderate proportion."

Such consistency and economy in operation is characteristic of Winther trucks. It enables contractors to handle their work surely and profitably.

Write us about your hauling requirements; let us tell you which capacity and type of Winther truck is best suited to your needs.

Winther Motor Truck Company

Manufacturers of Motor Trucks and Motor Cars

Kenosha, Wis.

WINTER TRUCKS

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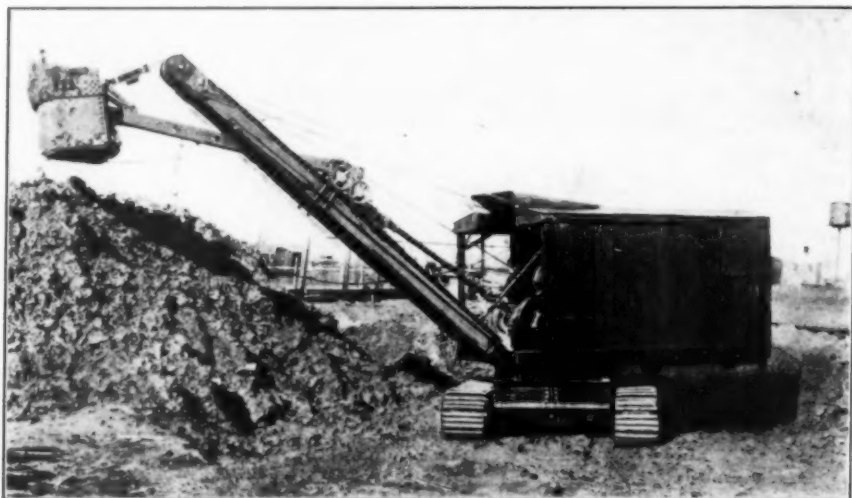
A Gasoline Trenching Machine

The Use of Liquid Fuel Facilitates the Operation of Shovel Excavators

A NEW type of trenching machine with full multi-pedal traction has been placed on the market by the Austin Machinery Corporation, 600 Railway Exchange Building, Chicago, Ill. It is designed to turn practically within its own radius and is a one-man machine. The full multi-pedal traction steers through heavy friction clutches on each side, its action in this respect being similar to that of the well-known military tank. It is of suffi-

of the sticky dirt and scrapes out each bucket as it passes a point at the head of the excavator boom directly over the conveyor belt. This can be adjusted to deliver the excavated material to either side of the machine.

The gasoline engine is of the 4-cylinder, 4-cycle type and is cooled by an enclosed radiator. Some of the details which are of interest to sewer, water, gas and electric line contractors are the following: The digging width of the



A 1-YARD SHOVEL OPERATED BY GASOLINE ENGINE AND EQUIPPED WITH TRACTION TREADS

ciently light weight to handle trenches for house connections, sewers, etc. The machine will cross sidewalks, climb over curbs, cross bridges and travel over all types of pavements.

A screw-hoist raises and lowers the digging arm automatically, and the endless chain of buckets are of standard type. The screw-hoist also acts as a lever to force the bucket to dig by crowding the bucket line against the face of the ditch or cut. A cleaning device takes care

18-inch buckets is from 20 to 28½ inches, and that of the 24-inch buckets from 26½ to 29 inches. The standard boom will dig up to 6 feet in depth, or the machine may, with additional equipment, dig to a depth of 8 feet. The conveyor belt is reversible so as to deliver dirt to either side. Another important feature is the interchangeability of the machine for digging trenches with vertical banks or small ditches with sloping sides.

Who Makes Locomotive Cranes or Traveling or Wrecking Cranes?

Frequently you are confronted with the question of who makes a specific kind of equipment. By consulting the "Where to Purchase" directory beginning on page 3 of the CONTRACTORS' AND ENGINEERS' MONTHLY your query is quickly answered.



USED AND REBUILT EQUIPMENT

At Attractive Prices



Craven's EQUIPMENT LIST SPECIALS

READ THIS LIST OVER AT LEAST—TWICE—

Let us know which of these items you need on your job.

We know that you cannot do better in quality, and we have made our prices so that you won't need to "shop around"—Would rather you would inspect it of course, but you don't have to, it is all **guaranteed** to be in good working condition at time of shipment.

**OUR BUSINESS IS TO SELL YOU GOOD USED EQUIPMENT
THE KIND THAT YOU NEED, AND TO SATISFY YOU**

So that you will come back to us for more.

Look over what follows, **PICK OUT YOURS**, and write us.

Lot No.	BOILERS	Price
1137	10 H.P. Loco. Type—Wheels.....	\$250.00
1126	25 H.P. Farquhar—Wheels.....	450.00
1138	100 H.P. H.R.T.—(2)..... Each	700.00
1139	75 H.P. H.R.T.—(2)..... Each	600.00
1150	75 H.P. Farquhar—Loco. Complete.....	800.00
1007	40 H.P. Neagle—Loco.—Skids.....	400.00

Lot No.	BUCKETS	Price
446	Brown—Hoist—1½ Yd. Clamshell.....	600.00
507	Blaw-Knox—1 Yd. Clamshell (Single Line).....	600.00
512	Hayward—Clamshell—1½ Yd.....	750.00
513	Hayward—Clamshell—1½ Yd. (1920).....	450.00
514	Hayward—Clamshell—1½ Yd.....	450.00

Lot No.	CABLE	Price
New	Never Unwound—1"–2"–3"–10,000 Ft.	
Lot No.	CONCRETE MIXERS—Concrete Buggies	Price
641	Ransome—21-S. Power Loader, Eng. and Boiler.....	3,000.00
642	Koehring—No. 16—Paver.....	950.00
649	Ransome—1 Yd.—Gaso.—P.L.	

Lot No.	CRUSHERS	Price
502	Champion No. 4—32 H.P. Motor.....	2,500.00
503	Climax No. 4—Belted to Eng. and Boiler.....	1,750.00
505	Climax No. 2—On Wheels—16' Elevator.....	1,400.00

Lot No.	DERRICKS	Price
496	Stiff-Leg—70' Round Boom, 3-Din. Lambert Hoist—32 H.P. A.C. Motor—Clamshell.....	6,000.00
497	Stiff-Leg—30' Boom—30 H.P. Vert. Boiler ½ Yd. Clamshell Bucket.....	750.00

Lot No.	DUMP CARS—AND OTHERS	Price
1037	Western—All Steel—4 Yd. 36" Gg..... Each	200.00
1040	Coal—Self-Clearing—80,000 Cap.....	
1042	Coal—Standard 100,000 Cap. Specification.....	

Lot No.	EXCAVATORS—DRAGLINES, ETC.	Price
137-138	Keystones—(2) No. 3.....	\$3,500.00 and 3,750.00

Lot No.	HOISTING ENGINES	Price
1677	Mundy (2) 6¼ x 10—3-Drum—Skeleton..... Each	650.00
1678	Mundy—6¼ x 10—3-Drum with Boiler.....	850.00
1572	Lambert—8¼ x 10—D.C.—D.D.—Boiler and Swinger.....	1,700.00
1588	Thomas—D.D.—Electric—50 H.P. D.C. Motor.....	950.00
1630	Stroudsburg—D.C.—D.D.—and No. 100 Boiler.....	
1680	Lambert—D.C.—D.D. and ASME Boiler—Cyl. 8¼ x 10.....	1,000.00
1681	American—D.C.—D.D. and ASME Boiler—Cyl. 8¼ x 10.....	1,000.00
1682	Mundy—7 x 10—D.C.—D.D. and Boiler.....	1,000.00
1683	Lambert—D.D.—82 H.P.—A.C. Motor.....	
1634	National—D.C.—D.D.—Skeleton—with Swinger—Cyl. 7¼ x 10.....	
1685	Lambert—7¼ x 10—D.C.—D.D. with Boiler and Swinger.....	1,650.00

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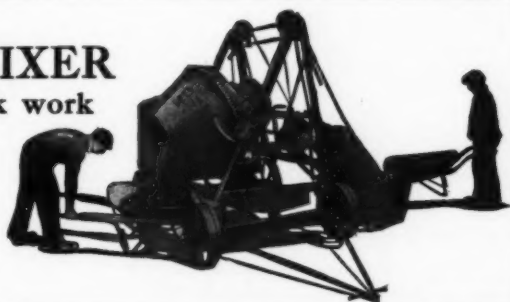
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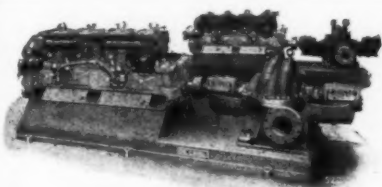
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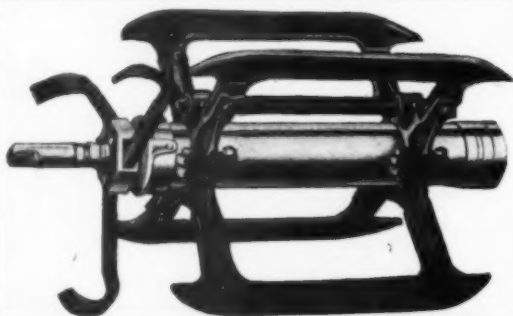
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Also Manufacturers of Meter Boxes, Meter Testing Machines, Adjustable Pipe Couplings

PUT YOUR PUMPING PROBLEMS UP TO PUMPING EXPERTS

Indiana "ECONOMY"

AIR LIFT SYSTEMS FOR WELLS,
Air Lift Separator-Pumps, Air Compressors, Air Receivers, Electric Motors, Centrifugal Pumps, Reciprocating Pumps, Deep Well Pumps, Impeller Pumps, Gasoline and Oil Engines, Indiana Engineering Service.

ASK FOR OUR

"Booklet on Deep Well Pumping"

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We have been manufacturing meters since 1870 and can furnish a line of the most accurate and durable fluid-measuring devices on the market. Besides water meters, we make meters for oil, gasoline, syrups, fruit juices or any other valuable fluid. We are pleased to give free consultation at any time to anyone with a liquid-measuring problem. Write us or call.

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Branch Offices
in principal cities.

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Furnishes thoro protection and gives entire satisfaction. Our catalog R tells the complete story—also tells about the CLARK METER TESTER—Valve Housings, Leak Indicator—and many other Water Works Appliances.

H. W. CLARK CO.

Manufacturers of
Everything for the Water Works
130 So. 17th Street, MATTOON, ILL.
New York Salt Lake City
San Francisco Chicago

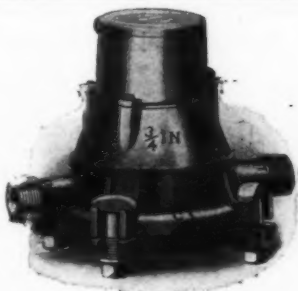
VENTURI METERS

are recognized as standard equipment for gravity mains, filtration plants, pump discharge lines, sewage disposal systems, hydraulic turbines, etc., by the most prominent municipalities.



Builders Iron Foundry
"Builders of the Venturi for 29 years"
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Type M
Register



Badger Water Meters Help to Stop Waste

Badger Water Meters guard the water supply against wilful waste, also make an appreciable cut in your coal bill.

Send us your address for information on how water meters can reduce overhead expenses.

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841-847 30th Street

Milwaukee, Wis.

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In no other meter can you find the Arctic characteristics—Dependable and Accurate registration, the breakable Frost Bottom which minimizes the possibility of damage by freezing and the unit assembly of measuring mechanism which makes low maintenance.

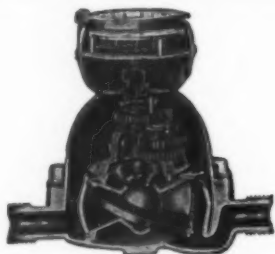
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Pittsburgh Meter Company

GENERAL OFFICE AND WORKS
EAST PITTSBURGH, PA.

New York—149 Broad-	Seattle—802 Madison St.
way	
Chicago—5 So. Wabash	Columbia, S. C.—1433
Ave.	Main St.
Kansas City—6 W. 10th	Los Angeles—Union Oil
St.	Building

Meters for measuring Water, Oil, Gasoline, Natural and Artificial Gas, Air, Oxygen and all other Gases and Liquids, either hot or cold, at any pressure.



Union Water Meter
produced to meet the
demands of all water
department service.

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Union Water Meter Co.
Worcester, Mass.

METERS

FOR OIL, GASOLINE
WATER, ETC.

25 YRS. ON THE MARKET
400,000 SOLD

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2898 Main St. Buffalo, N. Y.

LAMBERT WATER METERS

Made in all sizes, $\frac{3}{8}$ "
to 6", of best Bronze
Composition Thruout,
fitted with unbreakable
reinforced disc-pistons.

Write for booklet

THOMSON METER CO.
100-110 Bridge Street
Brooklyn, N. Y.

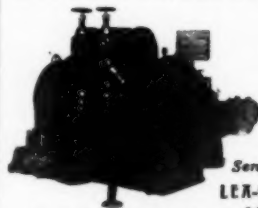
A PITOMETER SURVEY :: ::

Will positively unearth
all sources of water waste
including underground
leaks which cannot be
seen on the surface. Let
us prove it to you by
demonstration in a "Test
District."

*Send us your address for
further information.*

The Pitometer Co.
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LEA-COURTENAY PUMPS.



Centrifugal
pumping
machinery
for every
pumping
service

Send for Bulletin H-4

LEA-COURTENAY CO.
14 Maine Street
Newark, N. J.

Lea-Courtenay standard
Underwriters' Fire Pump

BOWSER

The Symbol For
CONVENIENCE
EFFICIENCY
ECONOMY
SERVICE
SAFETY

In Oil & Gasoline Handling Equipment
S. F. Bowser & Co. Inc., Fort Wayne,
Ind., U. S. A.

Illustrated book—free

The eye-opening story of wood pipe—its life, uses and economy—is interestingly told in the finest pipe book ever printed. The data file of NO engineer or Contractor who in any way recommends, or influences decisions for pipe, is complete without a copy. Request yours today. * * * WESTERN WOOD PIPE PUBLICITY BUREAU, White Bldg., Seattle, Wash.—Monadnock Bldg., San Francisco, Calif.

Redwood Douglas Fir **WOOD PIPE** **CONTINUOUS STAVE—WIRE WOUND—BORED**

Estimates of Cost of
Proposed Work
Reports on New Im-
provements
Preparations of Plans
Supervision of Con-
struction

Dams and Reservoirs
Pipe Lines
Filtration Plants
New Water Supply
Systems

JAMES P. WELLS

**HYDRAULIC ENGINEER
SPECIALIST IN WATER
SUPPLY ENGINEERING**

Main Office
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In the South, Central West and Canada



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For All Industrial Uses

Red Cross Extra, Gelatin and Straight Dynamites, Du Pont Extra Gelatin and Straight Dynamites, Repauna Gelatin, Du Pont Blasting Gelatin, Du Pont R. R. P., Permissible Explosives, Blasting Powders.

Send for descriptive booklets and price lists.

E. I. du Pont de Nemours & Co., Inc.

Sales Department, Explosives Division
WILMINGTON, DELAWARE



Iron Horse Metalware for Contractors'

Galvanized Cans	Engineers' Cans
Pails	Oily Waste Cans
Rubbish Cans	Ash Cans
Garbage Cans	Corrugated Baskets

SEND FOR OUR CATALOGUE

ROCHESTER CAN CO.
109 Hague St. Rochester, N. Y.

UNION METAL LAMP STANDARDS

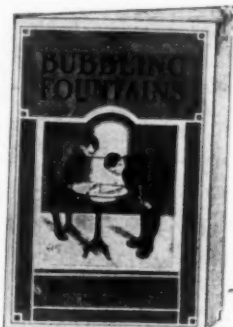


Union Metal and General Electric engineers will point out for you the "Right way for your White Way," whether your requirements be a large spectacular business district standard or a small, modest type for parkway or private grounds.

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**The Union Metal
Manufacturing Co.**
CANTON OHIO

**UNION METAL
LAMP STANDARDS**



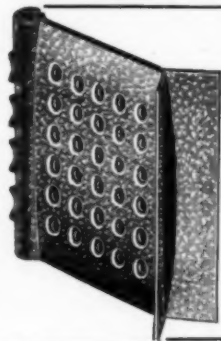
SLANTING-JET Drinking Fountains SAVE WATER

The Vertico-Slant Drinking Fountain saves 66 2/3 per cent of the water as compared with a number of the old style globe shaped vertical bubbling heads.

Our new 74 page drinking fountain Catalog "C" is ready for distribution.

**RUNDLE-SPENCE
MFG. CO.**

Milwaukee, Wis.



NIAGARA WALL PLUGS, (TWO SIZES)

For building into Walls of Brick, Stone or Concrete as a base for nailing.

OTHER SPECIALTIES

Galvanized Wall Tie 7 1/2 inch; Galvanized Wall Tie 12 inch; Galvanized Veneer Tie; Steel Sash Pulleys; Steel Sash Fastener; Steel Sash Chain; Chandelier Chain.

Samples on request. Ask for Folder 67.

**NIAGARA METAL STAMPING
CORP.**

235 10th St., Niagara Falls, N. Y.

THE MARK
OF QUALITY

REGISTERED
ECONOMY
U. S. PAT. OFFICE

17 PROTECTA
THE USER

By equipping with **ECONOMY DRAFTING ROOM FURNITURE** your drafting room will be more efficient for **ECONOMY TABLES**, enables the draftsman to work with greater speed and accuracy, and **ECONOMY SECTIONS** enable him to fill his blue prints and tracings **NEAR HIM**.

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Adrian Michigan

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Send for our booklet, "Assessment Maps—
Their Construction and Upkeep"

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ELECTRICAL PRODUCTS

To develop machinery for the generation, transmission, distribution and utilization of electricity in the form of light, heat and power, has been the aim of the General Electric Company for more than a quarter century.

G-E engineers in sales offices in all large cities are ready to assist in any problem where electricity may be used.

General  Electric
 General Office Schenectady, N.Y. **Company** Sales Offices in all large cities

SIMPLEX WIRES AND CABLES — FOR — STREETS AND PARKWAYS

Steel Taped Cables
 For underground service without conduits, Easy to handle and inexpensive to install. It is flexible.

"Fibrex" Tree Wire
 For overhead service among trees. Covered with a non-metallic, non-inductive armor that resists abrasion.

SIMPLEX WIRE & CABLE CO

MANUFACTURERS

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 CHICAGO SAN FRANCISCO

Make Your Own Blue Prints Automatic-Continuous-Economical

Makes prints up to 48 inches in width and of unlimited length, ample storage for blue print paper and completed prints. Our booklet gives details, a copy is yours for the asking.

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Saginaw, Michigan

King Street Lighting Standards

Write for illustrated matter

MADE BY

KING MANUFACTURING COMPANY

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ELRECO COMBINATION RAILWAY and LIGHTING POLES



Make Lamp Standards unnecessary, one pole at half the cost does double duty—supports the trolley span wires, also ornamental bracket and handsome Lighting Fixture.

Full details in Catalog F—sent on request.

Electric Railway Equipment Co.

Cincinnati, Ohio

New York Office, 30 Church St.

INDEX TO ADVERTISERS

After referring to the "Where to Purchase" Section, on pages 3 to 37, if you will look up the advertisements as per index below, you will be able to secure further data (with illustrations in many cases) on the material or equipment relative to which you are seeking information.

Acme Road Machy. Co.....	22	Gamon Meter Co.....	92	Pacific Flush-Tank Co.....	90
Allis-Chalmers Mfg. Co.....	89	General Electric Co.....	97	Packard Motor Car Co.....	82
Alpha Portland Cement Co.....	88	General Motors Truck Co.....	99	Pawling & Harnischfeger Co.....	14
American Well Works.....	89	Good Roads Machinery Co.....	18	Payne Dean Limited.....	91
Arcadia Trailer Corp.....	86	Granite Pav. Block Mfrs. Assn.....	87	Pennsylvania Salt Mfg. Co.....	88
Austin-Western Road Mach'y Co.....	28	Gray Iron Foundry Co.....	8	Pioneer Asphalt Co.....	22
		Grey Steel Products Co.....	83	Pitometer Co.....	94
		Grinnell Co.....	90	Pittsburgh-Des Moines Steel Co.....	36
				Pittsburgh Filter & Eng. Co.....	92
Badger Meter Mfg. Co.....	93			Pittsburgh Motor Co.....	93
Baker Mfg. Co.....	24	Heil Co., The.....	24	Porter Co., H. K.....	16
Barber Asphalt Paving Co.....	100	Heltzel Steel Form & Iron Co.....	22		
Barret Company, The.....	86	Hersey Manufacturing Co.....	92		
Best Tractor Co., C. L.....	85	Hollow Building Tile Assn.....	86		
Bitotag Paving Co.....	84	Holt Manufacturing Co.....	84		
Bowser & Co., S. F.....	94	Honhorst Co., Jos., The.....	84		
Briggs, Inc., Marvin.....	82				
Bucyrus Co.....	30			Ransome Concrete Machy. Co.....	88
Buffalo Meter Co.....	94	Indiana Air Pump Co.....	92	Rensselaer Valve Co.....	88
Buffalo-Springfield Roller Co.....	24	International Motor Co.....	85	Rochester Can Co.....	96
Builders Iron Foundry.....	93			Rundle-Spence Mfg. Co.....	96
Burch Plow Works Co.....	16				
Busch-Sulzer Bros.-Diesel Eng. Co.....	88	Jaeger Machine Co.....	83		
		Johnson, Inc., Edw. E.....	88		
				Sargent Lumber Co.....	94
Carey Co., Philip.....	86	Kelly-Springfield Tire Co.....	85	Simplex Valve & Meter Co.....	92
Central Foundry Co.....	77	King Mfg. Co.....	97	Simplex Wire & Cable Co.....	97
Clark Co., H. W.....	93	King, Philip T.....	82	Smith Mfg. Co., A. P.....	91
Cleveland Tractor Co.....	32	Kinney Mfg. Co.....	10	Standard Oil Co. of Indiana.....	75
Conklin & Harrington, Inc.....	84	Koehring Machine Co.....	6	Standard Scale & Supply Co.....	37
Couney & Co.....	36	Koppel Indus. Car & Equip. Co.....	16		
Crane Co.....	91				
Craven Co., Frank T.....	81				
Dayton-Dowd Co.....	88	Lea-Courtenay Co.....	94	Texas Company, The.....	1
De Laval Steam Turbine Co.....	89	Lee Trailer & Body Co.....	83	Thew Shovel Co.....	30
Delaware Clay Products Co.....	37	Lithoprint Co. of New York.....	96	Thomson Meter Co.....	94
Dow Chemical Co.....	86	Littleford Bros.....	8	Tiffin Wagon Co.....	84
Duff Mfg. Co.....	29	Lynchburg Foundry Co.....	88	Titan Equipment Co.....	83
Du Pont de Nemours & Co., E. I.....	87-95			Truscon Steel Co.....	81
Dustoline for Roads Co.....	84	Mathieson Alkali Wks., Inc., The.....	36	Turbine Sewer Mch. Co.....	90
		McGraw-Hill Co.....	2		
		McKiernan-Terry Drill Co.....	12		
		Midwest Engine Co.....	87		
		Mueller Mfg. Co., H.....	91	Union Metal Mfg. Co.....	96
		Municipal Supply Co.....	30	Union Water Meter Co.....	94
				Universal Road Machinery Co.....	22
East Jersey Pipe Co.....	90			U. S. Cast Iron Pipe & Fdy. Co.....	40
Economy Drawing Table and Mfg. Co.....	96	National Meter Co.....	93		
Electric Railway Equipment Co.....	97	Nat'l Water Main Cleaning Co.....	87		
Electro Bleaching Gas Co.....	36	Neptune Meter Co.....	26		
Engineering News-Record.....	2	Newport Culvert Co.....	4		
Equitable Asphalt Maint. Co.....	22	Niagara Metal Stamp Corp.....	96	Wallace & Tiernan Co., Inc.....	34
		Nordberg Manufacturing Co.....	89	Waring-Underwood Co.....	16
		Northern Fire Apparatus Co.....	92	Warren Bros. Co.....	83
		Norwood Engineering Co.....	88	Wells, James P.....	95
				Western Wood Pipe Pub. Bureau.....	95
Fairbanks, Morse & Co.....	90			White Co., The.....	83
Ford Motor Box Co.....	92	Ottersen Auto Educator Co.....	90	Wickes Bros.....	97
Forsythe Bros.....	82	Owen Bucket Co.....	8	Winther Motor Truck Co.....	79

Manufacturers who advertise in alternate issues may not appear in the above INDEX, but are carried in bold face type in the WHERE TO PURCHASE section at the front of this magazine. Readers wishing catalogs or further information regarding the products of these manufacturers should write to the CATALOG DEPARTMENT, CONTRACTORS' & ENGINEERS' MONTHLY, TRIBUNE BUILDING, NEW YORK CITY.



90
82
14
91
88
22
94
36
92
93
16

38
88
96
96

24
92
97
91
75
37

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84
83
85
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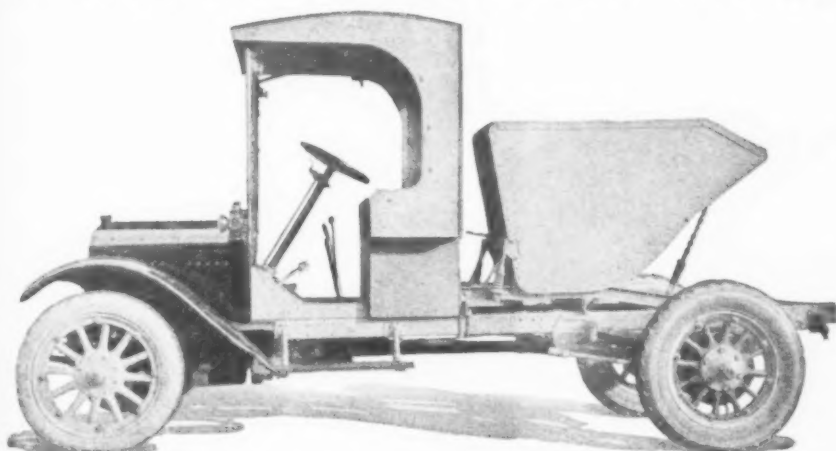
06
94
22
40

34
16
85
95
95
83
97
79

4
8
5
5
5
3
7
9



General Motors Trucks



GMC Road Builder

The GMC Road Builder is a specially equipped motor truck with capacity of one yard of concrete or other material. Body so arranged that load is well balanced on both axles. The special equipment can be removed easily, leaving a regular chassis on which a standard body can be used—making it an all-year utility—This is chassis standardized by U. S. Army and of which thousands were used overseas. Ask any soldier who was in France how they stand the abuse.

*Ask us for special circulars on this Road Builder—
We make trucks in all capacities from $\frac{3}{4}$ to 5-ton.*

GENERAL MOTORS TRUCK CO

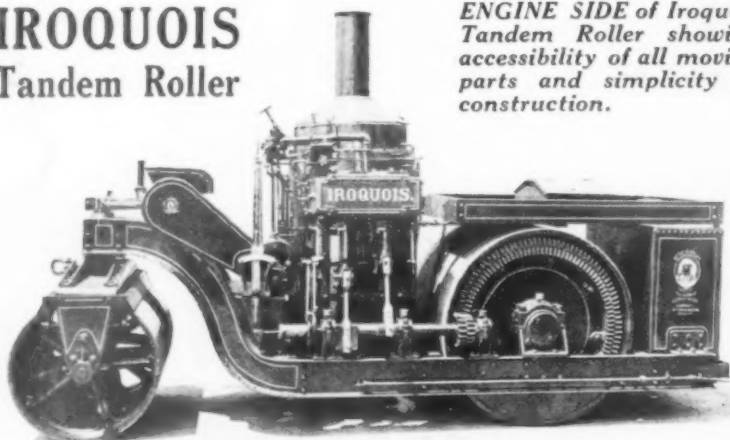
Pontiac, Michigan

Branches and Distributors in principal cities



IROQUOIS Tandem Roller

*ENGINE SIDE of Iroquois
Tandem Roller showing
accessibility of all moving
parts and simplicity of
construction.*



"Iroquois Equipment Makes Contracts Pay"

Iroquois Tandem Rollers are used by most successful contractors in many parts of the world. Leading municipalities have adopted them as standard equipment. *There is a reason.*

Iroquois Tandem Rollers, like other products of the Iroquois Line, are the result of 40 years' experience in the designing and actual operation of street-paving and road-building equipment. Iroquois users profit by our experience.

Iroquois Tandem Rollers are built to last. They have a low-speed engine that insures high-power, quick reverse and long life. A separate two-cylinder, double-action engine gives power steer.

Iroquois Tandem Rollers are made in three sizes—2½-ton, 5-ton, and 8-ton. They are equally successful for rolling asphalt, brick, creosote block, macadam, grade or golf links.

Do you need a roller at once? A telegram starts an Iroquois Tandem Roller enroute the same day. You get the best roller made—in the *quickest possible shipping time.*

Wire or write at once. Detail specifications and prices will be sent on request.



Trade Mark
Reg. U. S. Pat. Off.

The Barber Asphalt Paving Company

Iroquois Sales Department

Philadelphia

